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DIAGNOSIS OF THE OCCURRENCE OF TOXEMIA OF PREGNANCY BY EXAMINATION OF THE UNKNOWN PLACENTA*

STUDY OF 100 CASES

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IN DECEMBER, 1932¹ we described the lesions found on section of 1,000 consecutive placentas from both normal and toxic cases, and in the classification proposed at that time, recognized the acute type of placental infarct first described by Young,² and noted the consistency with which it was found in cases of toxemia of pregnancy.

Contrary to Young's hypothesis, which attributed the infarct to blockage of the maternal blood supply, our investigations indicated it resulted from blockage of the fetal blood supply, due, probably, to thrombosis or even rupture, induced by the trauma of vigorous fetal movements on the exposed fetal arteries on the surface of the placenta. Positive proof that actual rupture of these vessels may at times occur, is seen in Figs. 5 and 8 of the above-mentioned article.¹ Furthermore, thrombosis of the villous capillaries is frequently found in infarcts of the more acute type.

In no other situation or under no other condition, do we find a circulation so unprotected and at the same time so exposed to trauma as is the fetal circulation on the surface of the placenta. Furthermore, the shape and size of the uterus, the relatively greater freedom of motion of the fetus and the relation of the placental site to the extremities of the fetus, render the human placenta more subject to trauma than that of many of the lower animals.

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Evidence that toxemia of pregnancy is the result of absorption of poisonous protein split products of autolysis of infarcted placental tissue, was further supported by producing the clinical symptoms of eclampsia and characteristic pathologic changes in liver and kidneys of guinea pigs by repeated injections of autolysate of human placental tissue.

In January, 1934³ we advanced the theory that autolysate of placental tissue probably contains a higher content of guanidine than that of any other tissue, because of the fact that placental tissue contains twice as much arginine as any other tissue.⁴ A possible mode of derivation of guanidine from arginine was described, and since guanidine is known to raise blood pressure and produce convulsions,⁵ the peculiar eclamptogenic property of autolyzed placental tissue may thus be explained. This theory is supported by the fact that Kracke, in giving repeated injections of autolysate of other tissues to produce artificial leucocytosis in rabbits, has never produced convulsions, although they may be readily produced by autolysate of placenta tissue.⁶

In April, 1936⁷ we described certain focal changes visible beneath the endothelium and in the wall of some of the smaller placental arteries and apparently more frequent in toxic cases, which were typical, in appearance, of cholesterol vascular change, such as is found in coronary thrombosis and in experimentally produced atherosclerosis in cholesterol fed rabbits.⁸ Large fat cells appear beneath the endothelium, narrowing and distorting the lumen and invading and weakening the vessel wall.

It therefore seemed probable that the well-known hypercholesteremia of pregnancy supplied the missing link in the chain of evidence by which the infarction is readily explained, through its tendency to narrow the vessel lumen, roughen the endothelial lining or weaken the vessel wall, thereby causing occlusion, thrombosis or rupture. We still adhere to the importance of the role played by the trauma of fetal movements, for it has been shown⁹ that cholesterol vascular change occurs much more readily at the site of trauma to the vessel wall, and, following such change, trauma, in turn, is much more likely to cause rupture of the vessel at that point.

In the same publication, we furthermore stressed the importance of the role which the pituitary gland probably plays through control of cholesterol metabolism, and which hypothyroidism undoubtedly plays in causing excess hypercholesteremia and that thyroid extract or iodine, when indicated, may control excessive hypercholesteremia.

In pregnant women of this particular endocrine type, hypercholesteremia renders them potential victims of toxemia. In other words, certain patients who seem prone to develop toxemia in successive pregnancies, are not increasingly susceptible to toxemia because of the first attack, but because of their fundamental endocrine type and hypercholesteremia.

In addition, we stressed the fact that a cholesterol-rich or -poor diet influences the degree of hypercholesteremia and is, therefore, an important determining factor in the frequency of eclampsia. This probably ac-

counts for the geographic variations in the incidence of eclampsia, and the lessened frequency of eclampsia in Germany during the World War.

The above-mentioned fundamental factors of hypercholesteremia, hypothyroidism, cholesterol vascular change in the placental arteries and placental infarction have since been emphasized by Patterson, Hunt and Nicodemus¹⁰ in 1938, but comment on certain features of their theory is deferred to the concluding portion of this article.

Our previous knowledge and classification of placental lesions were developed by examining "known placentas"—that is, the clinical record of the patient was reviewed just before the placenta was cut. One is likely to be influenced in his judgment of a questionable lesion, if he knows, in advance, whether or not the patient had toxemia. It is one thing to examine the cut strips of a "known placenta" and find lesions which may be regarded as significant. It is quite another thing to examine the cut strips of an "unknown placenta" and commit oneself to a statement as to whether the patient had toxemia, and if so, whether it was mild, moderate, pre-eclamptic, eclamptic, or abruptio in type. This is the acid test for the specificity of certain placental infarcts for toxemia.

The fact that the relationship of acute placental infarcts to toxemia has not been generally appreciated or accepted, is due to neglecting to prepare and fix the placenta properly before cutting it, and to overlooking the more acute types of placental infarcts. The placenta should be prepared by cutting away the membrane, stripping the amnion from the fetal surface, wiping the maternal surface free of blood and fixing it for three to four weeks in 10 per cent formalin solution. It should then be examined by cutting it in strips of 0.5 to 1 cm. in diameter.

The investigation herewith described is based upon the examination of 100 placentas obtained from cases of normal pregnancy, mild toxemia, pre-eclampsia, eclampsia and abruptio and a few cases of pre-existing vascular disease associated with hypertension. Seventy-six placentas were obtained from our private patients, the remainder from the Colored Division of Grady Hospital and from other physicians.

The placentas, prepared in the above described manner, were examined as "unknowns," one of us (E. D. C.) removing the label immediately preceding the examination, following which the other (R. A. B.), dictated a description of the lesions found and an opinion as to whether the patient showed hypertension or albuminuria during pregnancy, and if so, as to the severity and type of toxemia. The clinical record was later examined and the pathologic and clinical diagnoses were compared. Through this method of examination, we have been able to arrive at a much more accurate classification of placental lesions than any we have heretofore proposed, and have found it possible to diagnose the occurrence of toxemia from the appearance of the placenta in 80 to 90 per cent.

With the exception of one placenta which showed extensive firm white infarction involving about one-fourth of the maternal surface, and several specimens of abruptio placentae, showing indented compressed placental tissue, there was no placenta which had any distinguishing

feature which might enable one to remember the specimen several weeks after delivery. The size of the placenta did not furnish a clue as to the identity of any case, since there was a number of slightly premature labors including both normal and toxic cases.

As an aid in recognition and classification of the lesions commonly found in the placenta and to create a better understanding of the criteria by which the degree and type of toxemia are judged, color photographs and descriptions of the lesions have been included.

The lesions have been designated by the letters *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H*. For emphasis and convenience, the italicized letters indicate the infarcts which are associated with increasing degrees of toxemia.

Infarct *A* (Fig. 1) is recognized grossly by its white color and firm consistency. The etiologic factor is apparently a gradual sclerosis which first affects the small terminal placental arteries on or near the margin of the placenta. The dependent villi undergo slow degeneration, extending over a period of one to several months. Since the surface of the villi serves as an endothelium to the intervillous blood channels, the slow necrosis induces thrombosis of the maternal blood, which gradually becomes hyalinized, causing the infarct to become firm and white from absence of circulation. Microscopically, the pale, faintly stained "ghost villi" appear to be imbedded in the homogeneous pink-staining hyaline substance (nonvascular or solid portion of Infarct *B*, Fig. 2).

There can be no toxemia resulting from Infarct *A*, not only because the protein split products of villous necrosis and autolysis are formed too slowly but also because intervillous thrombosis and hyalinization prevent diffusion of these products into the maternal circulation.

Infarct *B* (Fig. 3) is recognized by its yellow color and firm consistency. It is likewise usually found on or near the margin of the placenta. The etiologic factor is apparently a sclerosis or obliterative endarteritis slightly more active than in Infarct *A*. The thrombosed intervillous blood channels are incompletely hyalinized and the degenerating red cells have not completely disappeared, thereby imparting a yellow color to the lesion (vascular or open areas of Fig. 2).

In the early stage of formation, Infarct *B* may have been responsible for a transient slight edema or albuminuria or a slight rise in diastolic blood pressure, but it soon becomes incapable of causing toxemia for the reasons mentioned under Infarct *A*.

Infarct *C* (Fig. 4) is recognized by its brown-yellow color and moderately firm consistency. It is likewise usually found on or near the margin of the placenta but may occur elsewhere. The etiologic factor is probably a progressive arterial occlusion at the site of cholesterol vascular change, and more rapid than in Infarct *B*. Hyalinization of the thrombosed intervillous blood is incomplete, and there is active intervillous circulation in some parts of the infarct. The brown-yellow color of the lesion is due to partial degeneration of the red cells enmeshed in strands of fibrin. Pyknosis and karyorrhexis may be seen (Fig. 5).

Since necrosis of the villi has been slightly more rapid than in Infarct *B*, it is probable that peptone, one of the early products of autolysis, is present in sufficient amount to inhibit complete thrombosis, thereby permitting diffusion of small amounts of guanidine and histamine into the maternal circulation with manifestations of toxemia.

Infarct *C* may therefore be responsible for moderate edema, albuminuria, and hypertension in the latter part of pregnancy which may persist for some time without increase or may subside as thrombosis and hyalinization extend.

Clinically, we are wont to credit improvement in the patient to our therapeutics, but the real agent in bettering the patient's condition is increasing intervillous thrombosis which closes the paths of diffusion of the toxic protein split products of placental autolysis.

Infarct *D* is *acute* and may be found in an *early* or a *late* stage. The *late* stage (Figs. 6 and 7) is easily recognized by its distinct brown color. The consistency is so much firmer than the surrounding normal tissue that, on bending the strip, the lesion holds together or finally cracks rather than bends.

It may be visible on the maternal surface or concealed within the substance. The etiologic factor is apparently occlusion or thrombosis at the site of cholesterol change in a small placental artery. The exciting factor is probably the trauma of fetal movements which breaks the endothelium over the accumulated fat cells. Necrosis of the dependent villi is much more rapid than in Infarct *C*. The villi stain poorly, show more degeneration and some disintegration (Fig. 8).

Due to greater concentration of peptone, thrombosis is inhibited, and histamine and guanidine find more ready access to the maternal circulation, producing greater evidence of acute toxemia. The infarct is brown because degeneration of the red cells is less advanced; it is not as firm as Infarcts *A*, *B* and *C* because of the lesser degree of thrombosis and the absence of hyalinization. There is sufficient meshwork of fibrin and fusion of necrotic villi in parts of the lesion to cause the area to appear more homogeneous and compact.

Some of the villi show marked distention and rupture of the terminal capillaries, which probably accounts for the small, firm clots which are often seen adjacent to or within the infarct. It is probable that the presence or absence of clot depends not only on the concentration of peptone but also on the compatibility of the maternal and fetal blood.

Since the increasing toxemia causes spontaneous onset of labor or requires induction of labor, one can only surmise what appearance the infarct would have in the final stage of degeneration.

The finding of this type of infarct indicates the patient had a moderate to severe degree of toxemia which terminated in eclampsia or required induction of labor following several weeks of increasing blood pressure and albuminuria. The size and number of the infarcts bear a definite relation to the severity of the toxemia.

The *early* stage of Infarct *D* (Figs. 9 and 10) in contrast to the *late* stage, may be easily overlooked unless one examines the placental strips with care. Due to less degeneration of the red cells, the color is only slightly brown. The area of infarction is well demarcated if the strip is held level with the eye and toward the light. The surface is more homogeneous than the surrounding tissue and is shiny. The lesion cracks rather than bends. There may be dark or slightly brown firm blood clot within or adjacent to the area.

These physical characteristics are in accord with the microscopic pathology, which shows degenerated and disintegrating villi, open intervillous circulation, with occasional areas of blood clot and fibrin.

Infarct *E* is more acute than Infarct *D* and is likewise seen in an *early* and *late* stage in any part of the placenta. The etiologic factor is the same as described for Infarct *D*. The *late* stage (Figs. 11 and 12) is even more easily overlooked than the *early D* infarct. It is recognized by its dark, almost black color, and slightly firmer consistency which causes the surface to appear shiny and reflect light. On bending the strip the area cracks rather than bends. The black color is apparently due to stagnated venous blood in the congested villi, the capillaries of which are distended or ruptured. The nuclei of the villous cells are pyknotic and the stroma has a dull lusterless appearance. Soft to moderately firm dark clots may be seen within or adjacent to the area. Karyorrhexis and karyolysis may be seen in some parts of the infarct (Fig. 13).

Corner¹¹ correlated the histologic changes at various stages of autolysis and necrosis with the degree of chemical change in the tissue. In the normal spleen about 5.7 per cent of the total nitrogen is in the water soluble fraction in the form of ammonia compounds, aminoacids, peptones, purin bases, gelatin, etc., while 94.3 per cent of the nitrogen is in an insoluble, coagulable, precipitable form as proteins, nucleoproteins, and other insoluble organic nitrogen combinations.

At the stage of autolysis, *in vitro*, when pyknosis is marked, 7.4 per cent of the nitrogen is soluble. When karyorrhexis and karyolysis are marked, the water soluble nitrogen has increased to 26.5 per cent of the total nitrogen, due mainly to amino



1. Onset of mild toxemia at 35th week (Infarct B). Acute exacerbation at 39th week (late E Infarct).



3. Onset of very mild toxemia at 35th week (Infarct B). No exacerbation.



4. Toxemia, increasing from mild to moderately severe, over a period of three to four weeks, blood pressure increasing to 160/100 (Infarct C). Labor induced at 33rd week.



6. Acute toxemia of two weeks' duration (late D Infarct), terminating in eclampsia.



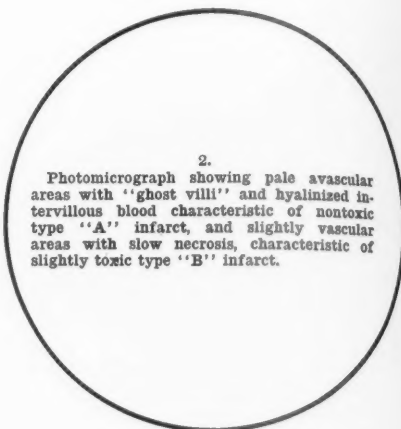
7. Onset of acute toxemia at seven months (late D Infarct), terminating in abruptio two weeks later. Very severe hematuria.



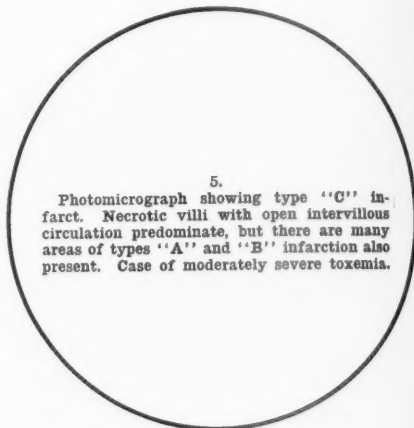
9. Mild toxemia 35th to 38th week (Infarct B); acute pre-eclampsia 39th week; induction of labor; three post-partum convulsions.



10. Moderately severe toxemia 37th week (early D Infarct), abruptio 39th week, labor induced. Survival of child favored by site of infarct and separation on margin.



2. Photomicrograph showing pale avascular areas with "ghost villi" and hyalinized intervillous blood characteristic of nontoxic type "A" infarct, and slightly vascular areas with slow necrosis, characteristic of slightly toxic type "B" infarct.

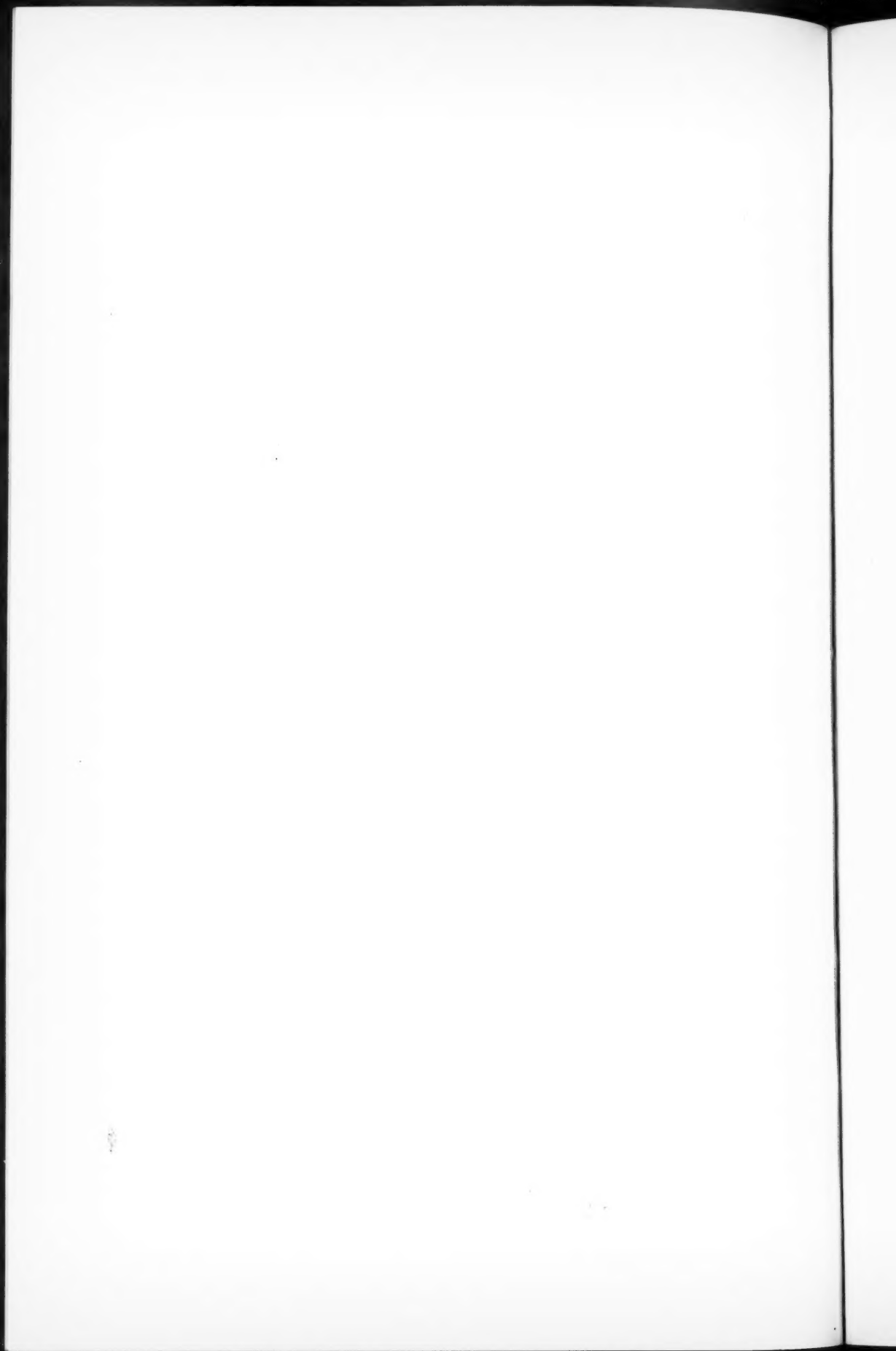


5. Photomicrograph showing type "C" infarct. Necrotic villi with open intervillous circulation predominate, but there are many areas of types "A" and "B" infarction also present. Case of moderately severe toxemia.



8. Photomicrograph showing type "D" infarct. Necrotic villi with open intervillous circulation. Many villi disintegrating. No areas of types "A", "B", or "C". Case of eclampsia.





acids, peptone, and simple nitrogen derivatives. When microscopic changes have practically ceased and the tissue appears to be disintegrated, the soluble nitrogen has increased to 30.3 per cent. The first products of protein disintegration are, therefore, the most toxic and with advanced cleavage the toxicity lessens.

The early form of Infaret *E* (Figs. 14 and 15) must be recognized almost solely by its dark, almost black color, and definite demarcation. The infarction is so early that disintegration has not occurred and the lesion still has the spongy consistency of normal placenta. It is responsible for the more fulminating cases of preeclampsia, eclampsia and abruptio placentae. Young,² who was the first to emphasize the relationship between placental infarcts and eclampsia, stressed the fact that the color change in some of the most acute infarcts may be so slight that it is very likely to be overlooked.

The villi show distention of many of the capillaries, some of which may be ruptured, with extravasation of fetal blood, forming soft black clots within or near the infarct. Various degrees of pyknosis, karyorrhexis, and karyolysis may be seen (Fig. 13).

Infarcts *D* and *E* may result in either abruptio placentae or eclampsia. The tendency to abruptio is greater if the infarct is exposed on the maternal surface of the placenta, thereby concentrating the effect of histamine on the adjacent decidual sinuses with resulting rupture, extravasation of maternal blood, and separation of the placenta.

If the case is one of abruptio, the causative infarct is almost invariably found underlying an indented, compressed area or hemorrhage on the maternal surface. One of the most important factors in the prognosis for the fetus, is the location of this infarct. If it is near the margin of the placenta, very little separation occurs and the fetus may survive (Fig. 10), but if it is near the center of the placenta (Fig. 14), the extravasation tends to separate the placenta and the fetus dies.

To Summarize.—Lesions *A*, *B*, *C*, *D* and *E*, are true infarcts, characterized by progressive increase in the rapidity of infarction. Grossly, the more rapid the infarction, the less conspicuous the lesion, the less firm the consistency, the darker the color and the greater the toxicity. Microscopically, the more rapid the infarction, the more open the intervillous circulation, the less apparent the intervillous thrombosis, and, except in the most acute stage, the greater the disintegration and loss of staining power of the villi. The range of color, due to change in the hemoglobin, is from very dark purple-black in Infaret *E*, to brown in *D*, to brown-yellow in *C*, to yellow in *B*, and to white in *A*. The size and number of the infarcts bear a definite relation to the severity of the toxemia.

In addition to the above described infarcts, there are several other lesions which are frequently seen but which have no specific relation to toxemia.

Lesion *F* (Fig. 16) is recognized as an excavation in the placental substance. The appearance suggests a forcible pushing aside of the villi, presumably by a sudden outpouring of fetal blood from a ruptured villus. If the fetal and maternal blood are compatible, the extravasation remains fluid and is soon removed through the intervillous circulation, leaving an excavated area which often shows a narrow rim of compressed placental tissue. This border simulates infarction but shows no microscopic evidence of necrosis (Fig. 17).

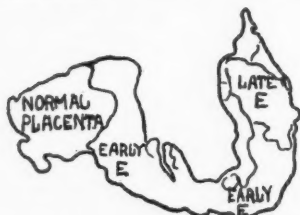
Lesion *F* occurs with great frequency in both normal and pathologic placentas and has no significance as to toxemia. One can merely speculate as to the cause, but we believe the lesion is best explained by the fact that from time to time in the latter months of pregnancy, the fetus, by its own movements or change in position, may compress the cord and cause temporary compression of the large thin-walled umbilical vein. Clinical evidence of this is seen in the temporary marked slowing of the fetal heart tones which may occasionally be heard in the latter months of pregnancy and unassociated with a uterine contraction. The same evidence, but more persistent and of serious significance, is obtained in the second stage of labor, if a coil of cord, around the neck, becomes compressed against the pubic bone. It is possible that the resulting increased distention of the capillaries of the terminal villi may cause some of them to rupture and produce the above described lesion.



11. Onset acute toxemia at 34th week (early D Infarct); pre-eclampsia at 36th week (late E Infarct). Labor induced.



12. Onset acute toxemia at 38th week (late E Infarct); pre-eclampsia within 10 to 14 days; labor induced; some hemorrhagic tendency; hematoma in perineal repair.



14. Acute toxemia at 32nd week (late E Infarct), terminating in severe abruptio 7 to 10 days later (extensive early E Infarct, involving four-fifths of placental strip throughout midportion, with indentation and separation of placenta); stillborn child.



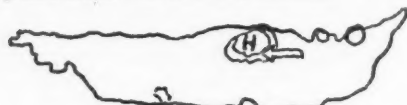
15. Onset acute toxemia 35th week, terminating in abruptio ten days later (early E Infarct).



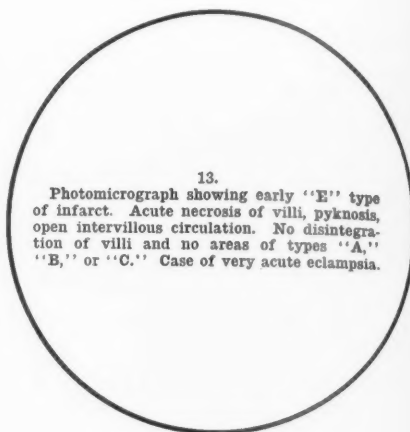
16. Excavated lesion (F), probably due to simple hemorrhage from ruptured villous vessel without infarction; subsequent absorption of blood, leaving open area.



18. Old simple hemorrhage represented by fibrin (G), with surrounding lighter anemic zone of compressed healthy villi, simulating infarction.



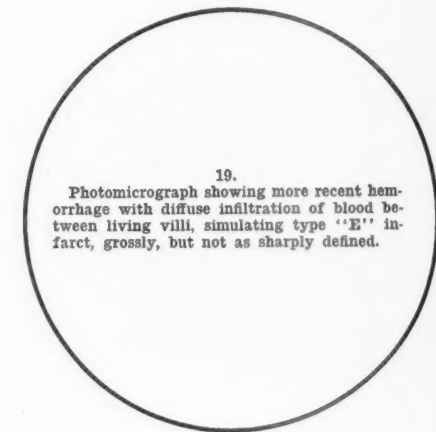
20. Transparent gelatinous area (H) resulting from incomplete clotting of a simple hemorrhage.



13. Photomicrograph showing early "E" type of infarct. Acute necrosis of villi, pyknosis, open intervillous circulation. No disintegration of villi and no areas of types "A," "B," or "C." Case of very acute eclampsia.

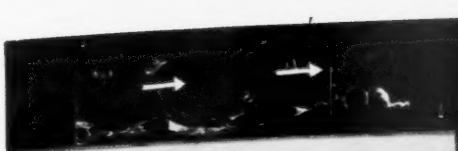


17. Photomicrograph of old hemorrhage (Fig. 18) within placental substance showing adjacent zone of living compressed villi. Note almost complete obliteration of intervillous spaces.



19. Photomicrograph showing more recent hemorrhage with diffuse infiltration of blood between living villi, simulating type "E" infarct, grossly, but not as sharply defined.

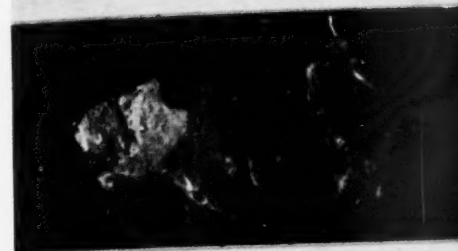
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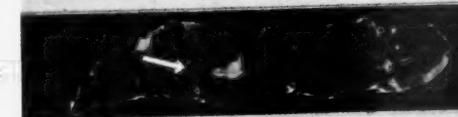
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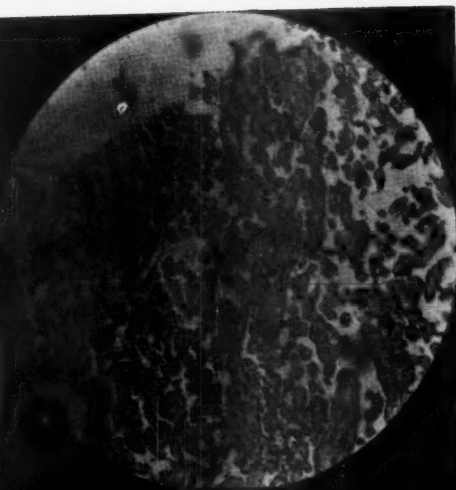
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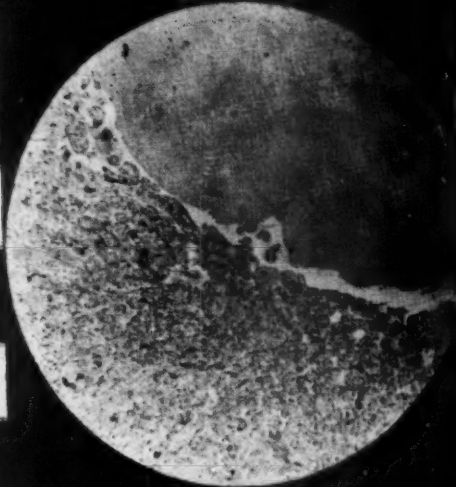
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Lesion G (Fig. 18) is of frequent occurrence and is merely a collection of blood surrounded by normal or slightly compressed placental tissue. If of recent origin, it is black or very dark red in color, but with increasing age and change in hemoglobin, it becomes brown with light striations of fibrin, then yellow and finally dull white in color. Theoretically, the etiology is the same as that of lesion F, but the extravasated blood is probably incompatible with the maternal blood, hence a coagulum results, rather than an excavation.

If lesion G is small and of recent origin, it may simulate lesion E, but the dark area is more diffuse and not so sharply circumscribed, and microscopically the villi do not show necrosis (Fig. 19). If it is old and of larger size, it may simulate Lesion A, but the fact that it may be picked apart as flakes of yellow fibrin serves to differentiate it. If a hemorrhagic area is fresh or recent, one should examine closely for possible adjacent acute infarction, but if yellow or gelatinous the evident age of the hemorrhage argues against an associated acute infarction.

Lesion H (Fig. 20) is recognized as a collection of transparent jellylike material, usually in the substance of the placenta. The appearance strongly suggests it may have originated from an extravasation of fetal blood, similar to Lesion G, but with sufficient incompatibility to form a soft coagulum, but not enough to form layers of fibrin. With absorption of hemoglobin, a transparent gelatinous substance remains. Occasionally one finds gelatinous lesions of a pink color due to unabsorbed hemoglobin, and in which shadows of red blood cells may be seen.

To Summarize.—Lesions F, G, and H are probably due to extravasations of fetal blood from rupture of terminal villous capillaries, due to temporary compression of the umbilical vein. If the fetal and maternal blood are compatible, the collection of blood remains fluid and is drained away, leaving an excavated area (F). With greater incompatibility, the lesion may vary from a transparent jellylike clot (H) to a firm clot (G) which passes through color changes from black to brown, to yellow and finally to the dull white color of fibrin. None of these lesions has any relation to toxemia, unless associated with acute infarction, in which case the hemorrhage is dark.

The relative frequency of the various lesions in this particular series was as follows: Infarct G, 68 per cent; Infarct A, 45 per cent; Infarct D, 38 per cent; Infarct F, 22 per cent; Infarct H, 22 per cent; Infarct B, 20 per cent; Infarct E, 20 per cent; Infarct C, 7 per cent. There were no lesions whatsoever in 3 per cent. Since these were selected cases, the above figures do not represent the natural relative frequency. It is evident that an absolutely normal lesion-free placenta is a rarity. There were only three placentas which showed no pathology.

There is some question as to the accuracy of the figures representing Infarcts E and G. The possibility of error arises from the fact that a small recent hemorrhagic area (G) may simulate an early infarction (late E or early D). In both bases the area is dark, but the hemorrhagic area is more diffuse, not so sharply demarcated from the surrounding normal tissue and more likely to be infiltrated with soft, black clot (Fig. 19). Some of these lesions may be difficult to differentiate without microscopic examination. There is no difficulty whatsoever in recognizing lesions A, B, C, late D, G (large hemorrhage), F, and H.

The following tables represent an analysis of the cases arranged in groups according to the type of infarct, and listed in the order of increasing toxicity from A to E, inclusive. The pathologic and clinical diagnoses are compared and the error in pathologic diagnosis estimated and explained.

In this group of 49 placentas (Table I), there were apparently none of the toxic lesions, B, C, D, or E, yet 10 cases showed mild or moderate toxemia and 3 cases severe toxemia, an error of 26.5 per cent. This was found to be due to mistaking small areas of true infarction (E or early D) for small hemorrhagic areas of the non-toxic early G type, or entirely overlooking a very early acute infarction.

In this group of 8 placentas (Table II), showing lesions of no greater toxicity than the B type, there were 7 in which the yellow color of the lesion was so slight

TABLE I

Placentas Showing No Lesions. Three Cases, or A, F, G, or H (Nontoxic Lesions)
Without B, C, D, or E (Toxic Lesions)—46 Cases. Total 49 Cases

	PATHOLOGIC DIAGNOSIS	CLINICAL DIAGNOSIS
No toxemia	49	36
Mild or moderate toxemia	0	10
Pre-eclampsia	0	1
Eclampsia	0	1
Abruptio placentae	0	1

TABLE II

Placentas Showing B, With or Without A, F, G or H, But Without C, D, or E.
Total, 8 Cases

	PATHOLOGIC DIAGNOSIS	CLINICAL DIAGNOSIS
No toxemia	7	5
Mild or moderate toxemia	1	3
Pre-eclampsia	0	0
Eclampsia	0	0
Abruptio placentae	0	0

that a diagnosis of mild toxemia did not seem justified. Two of these, however, showed slight toxemia—an error of 28.5 per cent. This may have been due to underestimating the toxicity of certain of the B lesions or mistaking small lesions of the toxic E or D type for small hemorrhagic areas of the nontoxic G type.

In this group of 3 placentas (Table III), showing lesions of no greater toxicity than the C type, there was one which showed no toxemia, an error of 33 per cent. Had this particular specimen been saved for re-examination, it is possible the error could have been explained grossly or microscopically.

TABLE III

Placentas Showing C With or Without A, B, F, G, or H, But Without D or E.
Total, 3 Cases

	PATHOLOGIC DIAGNOSIS	CLINICAL DIAGNOSIS
No toxemia	0	1
Mild or moderate toxemia	3	2
Pre-eclampsia	0	0
Eclampsia	0	0
Abruptio placentae	0	0

TABLE IV

Placentas Showing D With or Without A, B, C, F, G, or H But Without E. Total,
20 Cases

	PATHOLOGIC DIAGNOSIS	CLINICAL DIAGNOSIS
No toxemia	0	6
Mild or moderate toxemia	14	7
Pre-eclampsia	1	2
Eclampsia	4	4
Abruptio placentae	1	1

In this group of 20 placentas (Table IV), showing lesions of increasing toxicity up to and including D, which is usually associated with pre-eclampsia, eclampsia, and ab-

ruptio placentae, we found this particular lesion (*D*) so well defined and of such size or number in 6 placentas, that a pathologic diagnosis of pre-eclampsia, eclampsia, or abruptio placentae was made and verified clinically in each case. In another placenta the lesion seemed to indicate only moderately severe toxemia, but clinically the diagnosis was pre-eclampsia. The lesions in the remaining 13 placentas were small in size or number, hence, a diagnosis of mild or moderate toxemia was made. Six of these, however, showed no toxemia, clinically, and here again a recent nontoxic hemorrhagic area (*G*) was mistaken for a small toxic infarct of the early *D* type, accounting for an error of 30 per cent in the group as a whole. There was essentially no error in the pathologic diagnosis of the 7 severe toxemias.

In this group of 20 placentas (Table V) showing lesions of increasing toxicity up to and including *E*, which is associated with pre-eclampsia, eclampsia, or abruptio placentae of a more acute fulminating type, we found this particular lesion so well defined and of such size or number in 18 placentas, that a pathologic diagnosis of pre-eclampsia, eclampsia, or abruptio placentae was made and verified clinically in all but two cases, an error of 11 per cent. These two cases proved to be mild or moderate toxemia, and the 2 cases diagnosed pathologically as mild or moderate toxemia proved to be clinically nontoxic. Again, the errors were due to misinterpreting the nontoxic hemorrhagic lesion (*G*).

TABLE V

Placentas Showing *E* With or Without *A*, *B*, *C*, *D*, *F*, *G*, or *H*. Total, 20 Cases

	PATHOLOGIC DIAGNOSIS	CLINICAL DIAGNOSIS
No toxemia	0	2
Mild or moderate toxemia	2	2
Pre-eclampsia	6	5
Eclampsia	6	5
Abruptio placentae	6	6

If we group the cases of pre-eclampsia, eclampsia, and abruptio placentae in Tables I, IV, and V, it will be seen that out of 26 clinically proved severe toxemias, 24 were diagnosed by gross examination of the placentas, a correct diagnosis in 92 per cent.

It will also be seen that out of 24 cases diagnosed from gross examination of the placentas as severe toxemias, there were only 2 cases which clinically were not of this type, a correct diagnosis of 91.6 per cent.

We may therefore say that there is a definite association of the more acute types of placental infarcts with toxemia of pregnancy. In other words, if one knows the clinical course of pregnancy in regard to toxic manifestations, it is possible to predict quite accurately the type of infarct that will be seen in the placenta. Conversely, if one examines the unknown placenta, he may describe quite accurately the clinical course of the pregnancy in regard to toxemia.

The prevailing opinion would have it that these infarcts are the result of some unknown toxemia having its origin on the maternal side or from blockage of some of the maternal arteries supplying the placental site—the effect and not the cause of the toxemia.

The infarcts are sharply demarcated, both grossly and microscopically. Thrombosis is present in the great majority of villous capillaries and small arteries in the infarcted area. It is beyond reason that a hypothetical maternal toxin circulating freely throughout the placenta, and powerful enough to cause necrosis and disintegration of all villi in the

infarcted area, should, at the line of demarcation, be quite harmless to the surrounding, adjoining villi. Neither can it be envisioned how blockage in one or even several maternal arteries at the placental site could deprive the adjacent villi of blood from other maternal arteries, which is free to reach these villi through the open intervillous circulation.

We conceive the basis for toxemia of pregnancy to be laid down early in pregnancy by the physiologic hypercholesteremia of pregnancy, which is exaggerated in women of a hypothyroid endocrine type. In the latter months of pregnancy certain focal changes occur beneath the endothelium and in the walls of the small placental arteries, which are apparently identical with those seen in cholesterol-fed rabbits and in the coronaries of individuals dying suddenly of coronary thrombosis as seen in Figs. 1, 2, 3, and 4.⁷ These changes do not occur along the entire course of the artery but are focal, probably at points of greater stress or where the artery has sustained trauma from fetal movements.

With spontaneous breaking down of the lipid cells in such a focus, or due to the trauma of fetal movements, the endothelium overlying the focus is broken down and roughened and thrombosis occurs. Acute infarction of the dependent villi results which accounts for the sharp line of demarcation between the normal and infarcted tissue, corresponding to the arterial distribution. Necrosis and autolysis of the villi permits diffusion of poisonous protein split products, probably peptone, guanidine and histamine, throughout the maternal organism. The known pathologic effects of these three poisons apparently explains the symptomatology and pathology of toxemia of pregnancy.^{1, 5}

We note the prevalent tendency to regard toxemia of pregnancy, in some unknown way, as the result of vascular disease of the mother, disregarding the fundamental fact that identical vascular changes, when seen in the male or female, apart from the pregnant state, do not terminate in eclampsia or show the liver or kidney pathology of eclampsia. Three patients in our series had a pregestational vascular disease, but in no case did true pregnancy toxemia develop.

If ophthalmoscopic examination is made, coincident with or very soon after the first clinical manifestations of toxemia, edema, slight rise in diastolic blood pressure and slight albuminuria, one may note an occasional slight localized constriction or spasm in one or more of the retinal arteries. With increasing clinical symptoms and signs, the spasms become more numerous and change from sausage-like to spindle-shaped constrictions, and gradually the entire artery becomes spastic and reduced in caliber.

The evidence indicates that the arterial spasms are the effect and not the cause of the toxemia and are initiated in some way by one of the poisonous products of placental autolysis. Since guanidine is known to produce peripheral vasoconstriction, raise blood pressure,¹² and cause convulsions,⁵ it is probable that arginine, which is present in a relatively large amount in placental tissue, is the probable source of a relatively large amount of guanidine in the course of placental autolysis.

Experimentally, we know that autolysate of placental tissue, if injected into guinea pigs, produces convulsions and death, with liver and

kidney changes similar to those seen in eclamptic patients. We also know that autolysates of other cellular tissues, such as liver, spleen, or kidney, may produce toxic effects but do not produce convulsions. As stated before, we believe guanidine, histamine, and peptone are derived from autolysis of placental tissue, since the effects observed are so similar, clinically, to those seen in eclampsia. However, an initial recent attempt by Dr. Geo. Lewis, in the Department of Biochemistry, to prove this chemically by showing a greater amount of guanidine in the autolysate of placental tissue as compared with that of liver and spleen, has been unsuccessful, due to technical difficulties involved. This experiment, if successful, would constitute very important evidence in favor of the placental origin of eclampsia.

Granting that placental infarction furnishes a sound pathologic basis to explain the occurrence and manifestations of toxemia of pregnancy, we are better able to correlate certain recent lines of research which, up to this time appeared to be suggestive but unrelated.

Smith and Smith¹³ came to the conclusion that the high level of prolactin found in cases of late pregnancy toxemia, as well as the tendency to a low level of estrin, originate in a placental abnormality "which as yet remains unknown." This abnormality is undoubtedly infarction, the existence of which has hitherto been denied. The Aschheim-Zondek reaction is markedly increased in cases of hydatidiform mole and chorioepithelioma. It is likewise increased in cases of toxemia of pregnancy. Apparently the increase in prolactin and follicle-stimulating effect are the result of placental necrosis which is much greater in these conditions than in normal pregnancy.

Priscilla White¹⁴ in analyzing the pregnancies occurring in a series of diabetic women, noted the incidence of eclampsia to be 5 per cent, as compared with 0.3 per cent in a nondiabetic series. In the light of the known high cholesterol values in the blood of diabetic patients, we would attribute the high frequency of eclampsia to more pronounced cholesterol-vascular changes in the placentas of diabetic patients, with resulting increased incidence of acute infarction.

Vorziemer and others¹⁵ analyzed a series of 120 cases of toxemia from the standpoints of body weight, hair distribution, stature, facies, form of pelvis, basal metabolism, and blood proteins. In not one of the series was there significant impairment of renal function as studied by the concentration test and determination of the nonprotein nitrogen of the blood. In 35 patients on whom repeated observations of the basal metabolism were made, 68 per cent had basal rates below plus 10 per cent, which is the lower limit of normal during pregnancy. Ninety-eight per cent of the toxemic patients exhibited one or more of the endocrine stigmas under consideration, whereas only 15 per cent of the normal cases presented any stigmas.

Here again, hyperpituitarism and hypothyroidism are associated with excess hypercholesterolemia, which lays the basis for, and increases the liability to cholesterol vascular changes, placental infarction and toxemia.

Tenney¹⁶ noted a definite increase in the number of villi showing syncytial degeneration, in eclamptic cases as compared with normal cases. This is understood if we realize the toxic effects of the poisonous protein split products of placental autolysis, as they diffuse from the acute infarct through the intervillous circulation to reach the maternal circulation.

Eastman¹⁷ has raised the pertinent question that if we knew what caused the arterial spasms which are so much in evidence in toxemia of pregnancy, we would be near the solution of the actual cause of eclampsia. The clinical and pathologic evidences presented in this study indicate that arterial spasm is an effect and not the

cause of toxemia, and is probably due to guanidine as a product of placental infarction and autolysis. Increased guanidine compounds have been demonstrated in the blood of eclamptic patients.

Irving¹⁸ and Peters¹⁹ deny the existence of circulating toxins in eclampsia and attribute the pathology and symptomatology to the ischemia produced by widespread arterial spasm. We do not find the counterpart of the eclamptic syndrome and pathology in cases of essential hypertension or malignant hypertension in the male or female. Bell²⁰ states that the pathology in the kidney supports the view that a soluble toxic substance in the blood is responsible for eclampsia. It has been shown that if poisonous protein split products are injected into the blood slowly, toxic manifestations may be mild, whereas if the same dose is injected rapidly, the effect is severe. Diamond²¹ in a neuropathologic study of five cases of eclampsia which came to necropsy, concluded that the changes in the brain are similar to those present in severe toxic states in which there is a direct action of toxin on the parenchyma.

A study of the behavior of the basal metabolism in the course of developing toxemia of pregnancy, has progressed sufficiently to enable us to state, as a preliminary report, that a sharp rise of 30, 40, or 50 per cent almost invariably occurs at the onset of toxemia. This response is further evidence that toxemia of pregnancy is a true poisoning or intoxication and stimulates the thyroid in a manner similar to other intoxications.

Patterson, Hunt, and Nicodemus¹⁰ in a recent study based on our theory of the fundamental factors of hypercholesteremia, hypothyroidism, cholesterol vascular changes in the placenta, thrombosis, acute infarction, autolysis, and absorption of poisonous protein split products of placental protein, have verified the consistent association of acute infarction with eclampsia and have produced acute placental infarction and convulsions in thyroidectomized pregnant rabbits.

They believe that a hypothyroid mother makes up for some of her deficiency in thyroxin, by taking this substance from the fetus, thereby creating fetal hypothyroidism and hypercholesteremia, with cholesterol vascular changes in the placental vessels, thrombosis, infarction, and damage to the maternal kidneys by the autolytic poisons. They apparently consider the convulsions uremic in character, due to severe kidney damage. The latter part of this concept is not tenable, considering the lack of evidence of impairment in renal function.¹⁴ Furthermore, a theory of abstraction of fetal thyroxin, if applied to the human being, should confer a lessened risk of eclampsia in cases of multiple pregnancy, but we know the risk is considerably increased.

Maternal hypothyroidism is undoubtedly a strong predisposing factor in rendering the patient more liable to toxemia, but the normal hypercholesteremia in patients showing normal thyroid function, in conjunction with the vulnerability of the placental circulation to fetal trauma and focal cholesterol vascular change must still account for a large group of cases.

Biologically, if cholesterol is the framework of the body cell, it would seem that hypercholesteremia of pregnancy is rather a provision to meet the demands of embryonic cell growth, than the result of a chance maternal hypothyroidism.

We believe that the evidence presented in this study indicates that toxemia of pregnancy is due to placental infarction. Further investigation along the line of the biochemical aspects of the problem will undoubtedly clarify not only the exact poisonous protein split products which are involved but also explain certain variations in the clinical

picture of toxemia which are probably due to autolysis being suspended at various stages, thus causing peptone or guanidine or histamine action to predominate.

CONCLUSIONS

1. Placental infarcts of the more acute types are definitely associated with toxemia of pregnancy.

2. The hypercholesteremia of pregnancy is the basis for vascular changes in the placental arteries which predispose to infarction.

3. Hypothyroidism and a diet rich in cholesterol-containing foods are important factors in excessive hypercholesteremia.

4. The trauma of fetal movements on the placental arteries in the latter part of pregnancy is not only a predisposing cause of localized cholesterol change in the vessels but also an exciting cause of thrombosis or rupture at the site of such change, with resulting infarction.

5. The high content of arginine in placental tissue is the probable explanation of the specific eclamptogenic character of placental autolysate, through the formation of guanidine.

6. The known pathologic effects of guanidine, peptone, and histamine apparently explain the clinical and pathologic manifestations of toxemia of pregnancy.

7. The results of a gross examination of 100 placentas from both toxic and normal cases, as "unknowns," without knowledge of the clinical history, shows that it is possible to diagnose the occurrence of severe toxemia in 90 per cent of the cases.

8. Conversely, it is possible to predict the type of infarcts that will be found in the placenta, from a knowledge of the clinical history of the pregnancy as to toxemia.

9. With the experience of examining placentas as "unknowns," it has been found possible to establish criteria for an exact classification of placental infarcts and their relation to toxemia.

10. Further study of the effects of cholesterol and the biochemical aspects of placental autolysis, will clarify many of the clinical and pathologic manifestations of toxemia of pregnancy and will undoubtedly throw considerable light on the subject of hypertension and arteriosclerosis.

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1259 CLIFTON ROAD, N. E.

DISCUSSION

DR. EDWARD D. ALLEN, CHICAGO, ILL.—Dr. Bartholomew's paper should reopen the question of the cholesterol metabolism of pregnancy in general, particularly in view of the advance in knowledge of endocrine disturbances and the toxemias of pregnancy.

We can add some weight to his statements concerning the high incidence of the toxemias in patients with a lowered sugar tolerance. We are just completing a study of our series of diabetic pregnancies and find about the same incidence of toxemias as he has just cited. We have extended this study to include the non-diabetic glycosurias and find a similar incidence of toxemia. In fact, the transient glycosurias of early pregnancy have come to be a distinct warning for us of the later appearance of toxemia during the last trimester.

There has been an unfortunate choice of laboratory animals in the experiments on cholesterol deposition. The herbivora and the omnivora have different cholesterol metabolism. It might be well to repeat these experiments using carnivora or omnivora, especially the castrate. The castrate deposits larger amounts of cholesterol than the normal animal. This fact may be tied up with the relative quiescence of the ovary in the last half of pregnancy. Certainly atherosclerosis occurs much more commonly after the sex glands have become inactive.

The liver regulates the equilibrium between the free and esterified cholesterol. Parenchymal damage causes a fall in the esterified portion and parallels it. We have not seen so-called histamine shock in patients who did not show marked hepatic damage by the rose bengal liver function test.

In our previous studies of the toxemias the most constant blood findings have been a high total cholesterol and regularly low sugar values. The cholesterol values determined by the Blorr method have varied from 218 to 484. Dr. Dieckmann found values ranging from 128 to 750 with means of 320 mg. per cent and 303 mg. per cent for the pre-eclamptic and vascular renal disease, respectively. We have observed much higher total cholesterol values than these in the nephrotic patients of our medical co-workers, values up to 1,380.

Epstein states that the increased tolerance of nephrotic patients to thyroid medication is due to this elevated plasma cholesterol as they show no evidence of overdosage until these values are lowered.

We have recently begun a study of overweight pregnancies, nontoxic and toxic, with this fact in mind. The results are as yet too premature except to say that they give promise. Many of these women in spite of generally high metabolic rates tolerate doses of thyroid up to 11 gr. a day with no untoward symptoms. We have been unable to explain the reason for these high metabolic rates, although the patients clinically were definitely hypothyroid types.

Deposition of more than the usual amounts of cholesterol in the tissues usually is evidence of cellular injury or disease. Pathologists suggest that cholesterol deposits are evidence of slow death of the cell. Physiologic activity normally seems to determine the cholesterol content of different tissues. Certainly the placenta is a tissue of high physiologic activity which comes to senescence early. If we add to this the still unknown quantity which produces such marked tissue damage elsewhere such as the liver, kidneys, and brain, perhaps we have enough cause for the pathologic lesion of the placenta which Dr. Bartholomew has so convincingly described.

We are still loath to believe that these lesions are mechanical in origin or are the cause of the convulsions. Rather they are still another evidence of the varied character of toxemia which like syphilis affects different tissue aggregates in different individuals, probably according to the laws of constitutional pathology.

DR. NICHOLSON J. EASTMAN, BALTIMORE, MD.—In response to a request from Dr. Bartholomew we sent him ten placentas which had been soaked in formalin for several weeks, wrapped in formalin gauze and packed in an air tight container. The clinical diagnoses of these ten cases together with Dr. Bartholomew's diagnoses made from examination of the placenta are shown in the following table:

CASE NUMBER	CLINICAL DIAGNOSIS	DR. BARTHOLOMEW'S DIAGNOSIS
1	Pre-eclampsia	Acute toxemia
2	Eclampsia	Acute toxemia; abruptio placentae
3	Pre-eclampsia	Acute toxemia
4	Normal pregnancy	Eclampsia
5	Normal pregnancy	Normal pregnancy
6	Low reserve kidney (very mild)	Acute toxemia, moderately severe
7	Normal pregnancy	Normal pregnancy
8	Normal pregnancy	Severe pre-eclampsia or eclampsia
9	Pre-eclampsia, severe	Eclampsia
10	Eclampsia	Moderate toxemia or abruptio placentae

It will be seen that there were only two serious errors. In Cases 4 and 8, he made a diagnosis of eclampsia; in both of these instances the patients were entirely normal throughout the pregnancy, the highest systolic pressure in one being 118 and in the other 115. There was no toxemia at any time. These errors suggest that the placental lesions upon which he made his diagnosis of eclampsia are not absolutely pathognomonic of that disease. Considering, however, that Dr. Bartholomew had no clinical information about these cases, neither age, parity nor duration of pregnancy, the results in the other eight cases are excellent. In no case with clinical signs of toxemia did he fail to find evidence of the disease in the placenta. And it is interesting to note that his only errors were positive errors, that is, they lay in finding pathologic changes in the placentas of cases that were quite normal clinically.

DR. FRED L. ADAIR, CHICAGO, ILL.—At Dr. Bartholomew's request, we followed the same course as Dr. Eastman described in forwarding unknown placentas to the author. He returned us his diagnosis and description of the placenta without any knowledge as to the case itself from a clinical standpoint. Our clinical studies of the cases were compared with his studies of the placentas, with the following results in the 10 cases. The laboratory and clinical diagnoses check as to the presence of toxemia in 5 of the cases, but as to the degree of the toxemia in only 1, and as to the absence of toxemia in 2 cases.

Dr. Bartholomew's laboratory diagnosis was positive as to toxic states in 3 cases, but clinically our diagnosis was negative in all. In speaking of the presence or absence of toxic states, we admit that a variety of conditions and not a specific toxemia are included; this was accurate in 70 per cent and inaccurate in 30 per cent.

The following tabulation (Table I) shows the correlation between Dr. Bartholomew's diagnosis and our clinical diagnosis.

A number of years ago I made a rather extensive study of the placenta in relation to toxemias and concluded that placental changes were very frequent in so-called toxic states of pregnancy, but that in some cases of toxemia there were no placental changes demonstrable; further, that identical placental changes were to be found in other cases presenting evidence of infection, and in some which were normal. Therefore, while the so-called toxic states of pregnancy produce certain degenerative changes in placental tissue, they were not pathognomonic. Hence the changes in the placenta were not to be regarded as the etiologic factor in the toxemias but rather the result of the toxemia.

Dr. Bartholomew mentioned some of the effects of these placental degenerative changes of the fetus, particularly with reference to premature separation of the placenta. The chronic conditions naturally involve the fetus and do produce death of the fetus. However, in relation to the premature separation or detachment of

TABLE I. CORRELATION OF DIAGNOSIS OF TOXEMIA FROM PLACENTAS WITH CLINICAL DIAGNOSIS

BARTHOLOMEW'S DIAGNOSIS	CLINICAL DIAGNOSIS
1. Moderately severe acute toxemia	Moderately severe acute toxemia
2. Moderately severe pre-eclampsia	No toxemia
3. Fulminating toxemia, possibly eclampsia	Moderate toxemia
4. No toxemia	No toxemia
5. No toxemia	No toxemia
6. Severe pre-eclampsia or eclampsia	Severe pre-eclampsia
7. Prolonged toxemia with acute exacerbation before delivery, possible toxemia	No toxemia
8. Slowly increasing toxemia with abruptio placentae, and exacerbation of toxemia at delivery	Moderately severe toxemia, first diagnosed 5 days before delivery
9. Moderate toxemia, shortly before delivery	Mild toxemia
10. Mild toxemia	No toxemia

the placenta, most of these fetuses do not die from hemorrhage but from suffocation. As a matter of fact, the fetal death occurs rather rapidly and presents changes at autopsy which are definitely characteristic of asphyxia. The hemorrhage in premature detachment of the placenta comes from the mother and not from the fetus. The fetal hemorrhage of course ceases when the fetus dies and its death is due to asphyxia.

DR. THADDEUS L. MONTGOMERY, PHILADELPHIA, PA.—There is no question but what the careful study of the placenta will reveal many lesions which are closely related to health or disease in the mother and vitality or death in the fetus. Thus in long labor with premature rupture of membranes one will find in the secundines the evidences of inflammation, and in many cases of toxemia with elevated blood pressure the placenta contains hemorrhagic and thrombotic lesions or so-called "infarcts." The frequent occurrence of the latter has often raised the question of their significance, and many have undertaken to prove that they are the cause of eclampsia and allied conditions.

With this viewpoint Dr. Bartholomew is apparently in accord, and yet as I have reviewed his previous work and listened to his paper this morning, I can find no very certain proof that these lesions may not be the result of the toxic condition in the mother rather than the cause of it. In fact there are a number of circumstances which point toward the resultive rather than the causative relationship.

The theory which Dr. Bartholomew has presented is dependent upon acceptance of three views of placental physiology: first, that placental villi and chorionic epithelium are dependent upon fetal circulation for their nourishment; second, that degeneration of chorionic epithelium and of villi is preceded by a thrombotic or obliterative lesion in the corresponding fetal vessels; and third, that the subsequent degeneration of placental structures produces a material which upon absorption into the maternal system causes a systemic toxemia.

Contrary to these concepts, we have many points to indicate that the chorionic epithelium receives its nourishment from the maternal lake of blood and is generally independent of the fetal blood for its vitality. Certainly in the first few days of flourishing embryonic growth, it receives no sustenance from fetal circulation, and in the hyperplastic phases of activity in hydatidiform mole and chorioepithelioma fetal vessels are conspicuous by their absence. In fetal death from syphilis when the fetus is macerated and has evidently been retained in utero for several weeks, examination of the placenta usually reveals a healthy condition of the villi and preservation of the chorionic epithelium even though the development of fetal vessels in the villous stroma is obviously limited and the fetal circulation has long been arrested by fetal death.

The changes that take place in the maturing placenta also indicate that the source of nourishment of the plasmido and cytotrophoblastic layers is the maternal blood stream. Witness the contrast of growth of those villi which are in contact

with the rich blood supply of the decidua basalis and the attenuated blood vessels of the decidua capsularis. The resultant development is the thick succulent placenta at one site and the atrophic chorionic layer at the other, with a band of degenerated villi demarcating the two at the margin of the placenta.

And finally, if degenerated villi cause toxemia, why do we not uniformly have profound states of poisoning in missed abortion, retained dead fetus, with degenerated placenta, with placental necrosis and death of one fetus in binovular pregnancy.

Some time ago I published a study of the immediate and remote effect of small and large areas of premature placental detachment and pointed out that even in very recent separation necrosis of the placental villi and local chorionic epithelium takes place very rapidly, and this in instances where the general vitality of the fetus is unimpaired and its circulation active.

Aside from the work of Browne, little has been done experimentally to shed light upon the etiology of placental infarcts. The subject is a difficult one to deal with experimentally, but until something more is accomplished along that route the cause and the significance of necrosis of the placenta must remain obscure.

DR. BARTHOLOMEW (closing).—I am glad that Dr. Montgomery brought up the subject of intrauterine fetal death, which has been a puzzle to me in connection with this theory. Theoretically, if a baby dies in utero the placenta should die with it. Why does the patient not have fulminating toxemia at once?

I have studied these placentas, trying to explain why this does not occur and I cannot, as yet, explain it unless in the whole retroplacental area, with death of the baby, there is a shutting off or thrombosis of the retroplacental circulation.

Some work later on may be done to explain this apparent contradiction. But to my mind it does not weaken the evidence that I have seen over this period of years, of the close connection between infarcts and toxemia of pregnancy. It is so consistent that I cannot escape the conclusion that there is a definite association of infarcts and toxemia.

Objection has always been made to the idea that placental infarcts are the source of the toxemia rather than the effect. According to this, one would have to presuppose the existence of a hypothetical toxin circulating in the mother's blood, which would be capable of producing an area of infarction in the placenta.

If our conception of the placental circulation is correct, it seems inconceivable to me how a maternal toxin could have a selective action on any certain group of villi. As I showed in some of these microscopic sections, the intervillous circulation is entirely open, not only adjoining the infarct but within the infarcted area, yet these villi are necrotic, while just across the margin of the infarct we see healthy villi. Furthermore, the vessels of the necrotic villi in the infarcted area show thrombosis. It would seem that the vitality of the villi is dependent mainly on the villous rather than the intervillous circulation.

Furthermore, it has been suggested that placental infarcts result from shutting off of the maternal blood to a certain part of the placenta. Here again, one cannot conceive how an infarct could have its origin in this manner, since intervillous blood is free to reach this area from other directions.

The apparent mistakes which were made in the diagnosis of unknown placentas, furnished by Drs. Adair and Eastman, lead me to mention one fact which we have come to recognize. In the course of prenatal observations the findings on the last visit, perhaps a week or ten days previous, may have been normal. However, on admission to the hospital, in labor, we may be surprised to find an elevated blood pressure and albuminuria, due to an acute toxemia which has developed in this short time interval. Hence, if the patient is not given a final check-up in labor, the placental findings may seem to be incorrect.

STUDIES ON PELVIC ARRESTS*

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INTRODUCTION

THIS report is concerned with the importance of the size and shape of the pelvis in forceps deliveries, especially in regard to the low-medium and medium types. Observations have been made through the study of the pelvis by roentgenologic methods in conjunction with the description of the clinical procedure used to effect delivery from the occipito-anterior, transverse, and posterior positions. Conclusions have been drawn from the degree of ease or difficulty encountered in the mechanics of delivery. At this time interest is directed to the *mechanism used in the forceps delivery in relation to pelvic type* rather than the indications for the operative delivery.

MATERIAL AND METHODS

The size and shape of the pelvis and the fetal-pelvic relationships during labor are visualized in a specially-constructed stereoscope from stereoroentgenograms obtained according to the technic illustrated in Fig. 1. During the last six years a *selected* series of approximately 3,000 roentgenologic case studies have accumulated at the Sloane Hospital for Women and the Department of Radiology of Presbyterian Hospital, most of which have been obtained with this technic. For the purpose of this report, 500 cases have been chosen from this selected material and divided into five groups according to the method employed for delivery, namely spontaneous delivery of the average-sized infant (3,200 gm. or over), low forceps, low-medium forceps, medium forceps, and cesarean section. In order that the observations may be as significant as possible, these case studies were chosen by the consecutive pulling of films from the roentgen filing cabinets, beginning with the more recent cases and working through the series until 500 were obtained.

The architectural characteristics of the pelvis were studied in the precision stereoscope and classified according to a classification of pelvises previously described by us.^{1, 2} The anteroposterior diameter and widest transverse diameter of the inlet, the interspinous and intertuberous diameters were measured by means of the precision stereoscope. Each case study was analyzed in a uniform manner. This method of analysis of pelvic capacity is illustrated diagrammatically in Fig. 2.

The upper pelvis refers to the space between the plane of the inlet and a plane parallel to it at the level of the ischial spines. The mid-

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pelvis extends from the plane at the level of the spines to another parallel plane at the level of the lower border of the last sacral vertebra. The shape of this latter space is most important, especially in difficult forceps operations. The lower pelvis or outlet space lies between this third plane and another plane parallel to it at the level of the intertuberos diameter. These levels are somewhat similar to the four parallel planes of Hodge.³

The pelvis is divided into an anterior and posterior segment by a coronal plane passing through the widest transverse diameter of the

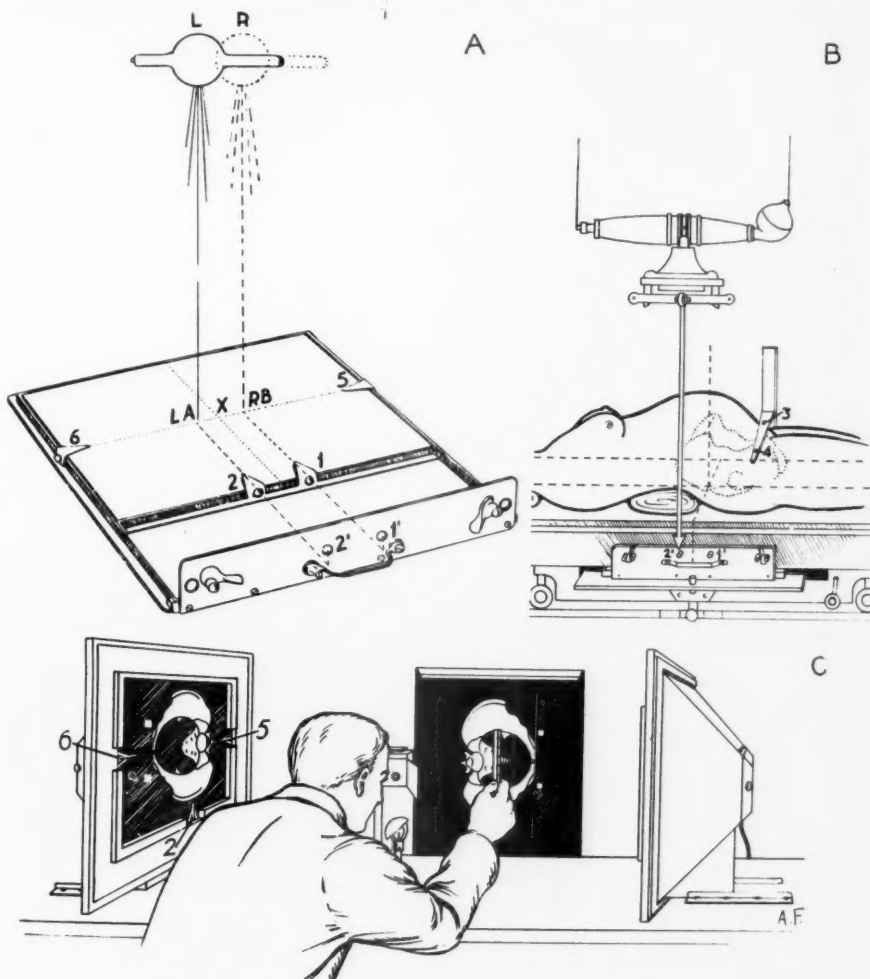


Fig. 1.—A, The cassette frame to mark the films for placement in the viewing box of the precision stereoscope (Fig. 1, C). The cassette frame is placed over the cassette on the cassette tray and fixed by lugs to the side of the x-ray table (see Fig. 1, B) 1' and 2'. With each shift the target moves along the line joining 5 and 6. For each exposure the target bears a perpendicular relationship to either 2, 2', or 1, 1'. B, The patient supine on the x-ray table with the lumbosacral pad in place. The target is centered just above the mid point of the line joining the anterior-superior iliac spines. Known marker 3 and 4 is suspended just free of the abdomen above the symphysis. C, The viewing surface of the precision stereoscope. The image of the arrow tips 5 and 6 and 2 and 1 are made to superimpose over corresponding lines marked on the celluloid edge of the viewing box. The complete examination also includes a 45 degree angle view of the subpubic arch and a lateral view of the pelvis. (Courtesy of the American Journal of Roentgenology and Thomas Nelson & Sons.)

inlet and through the interspinous diameter (Fig. 2, A and B). All anteroposterior diameters below the inlet are thus divided into two parts, an anterior sagittal diameter and a posterior sagittal diameter. Hitherto the terms *anterior* and *posterior sagittal diameters* have been used to define the distance between the under-surface of the symphysis and the midpoint of the interspinous diameter (anterior sagittal) and from this point to the tip of the sacrum (posterior sagittal). We believe these terms can also be applied to the two parts of anteroposterior diameters for each level of the pelvis as divided by the coronal plane (Fig. 2, B).

At the inlet the lengths of the anterior and posterior sagittal diameters and the widest transverse diameter vary according to the basic inlet type. Below the inlet, variations in the boundaries of the true pelvis may exist because of changes in pelvic shape as the outlet is approached. Thus the anterior and posterior sagittal diameters at lower levels are affected by variations in the inclination and curvature of the sacrum

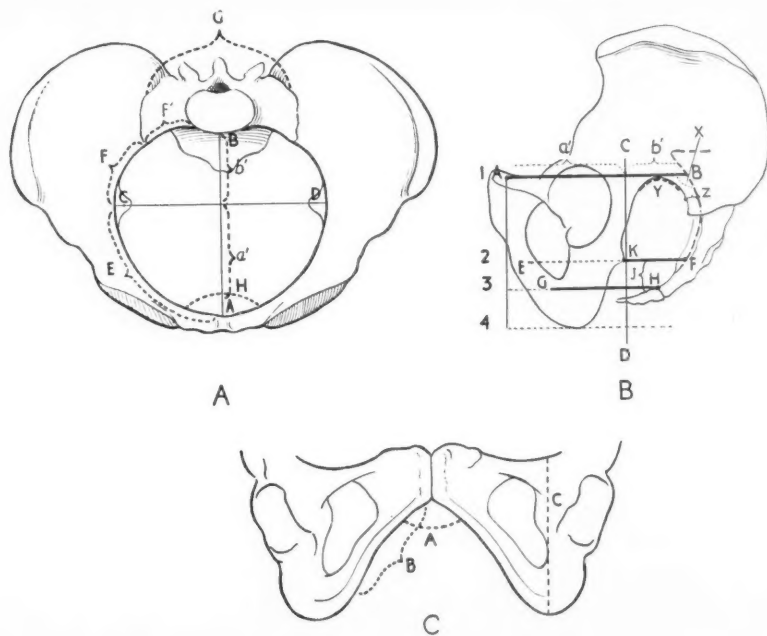


Fig. 2.—A, Analysis of pelvic capacity from the inlet view. CD, Coronal plane passing through the widest transverse diameter and the ischial spines to form the anterior and posterior segments. AB, Anteroposterior diameter of inlet and its two parts; the anterior and posterior sagittal diameter a' and b' . E, Anterior pubiliac boundary of the anterior segment. F, Posterior iliac boundary of the posterior segment. F', Sacral portion of boundary of posterior segment variable according to width of sacrum "G". H, Angle of fore pelvis behind symphysis (retropubic angle) variable according to pelvic type. B, Analysis of pelvic capacity as viewed from the lateral aspect. 1, 2, 3, 4, Parallel pelvic planes. CD, Coronal plane through widest transverse diameter of inlet and the interspinous diameter at right angles to the parallel pelvic planes. AE, Anteroposterior diameter of inlet with the anterior and posterior sagittal diameters a' and b' . Y, Size and shape of sacrosclatic notch. Variable according to pelvic type. Z, Section of ilium which may preserve good length to posterior sagittal diameter (b') in spite of a narrow sacrosclatic notch. X, Inclination of the sacrum, the size of the angle subtended by the plane of the inlet AB and the upper surface of the sacrum. KF, Posterior sagittal at level of ischial spines. GH, Anteroposterior diameter of outlet in front of the sacral tip. Note the level of the sacrococcygeal platform to the plane of the spines at J. C, Analysis of pelvic capacity, front view. A, Angle of subpubic arch. Variable in size and shape. B, Variations in curvature of pubic rami. C, Depth of true pelvis. (Courtesy of Am. J. Roentgenol.)

behind and the inclination of the symphysis and pubic rami in front. Transverse diameters from the inlet to the tuberosities of the ischium are influenced by the slope of the side walls of the pelvis, the length of the ischial spines, and the size and shape of the subpubic arch (Fig. 2, A and C).

The terms "lower anterior pelvis" and "lower posterior pelvis" are frequently used in the descriptions which follow. The lower posterior pelvis refers to the space above the sacrococcygeal platform (*H* in Fig. 2, *B*), while the lower anterior pelvis (or outlet space) refers to the space in front of and below the sacral tip or, more precisely, to the interval between the plane of the sacral tip and the plane of the intertuberous diameter.

The significant anteroposterior diameter of the outlet space extends forward as the third parallel plane into the free space of the subpubic arch (*GH*, Fig. 2). The significant transverse diameter of the outlet space extends between the posterior inner margins of the ischial tuberosities.

At and below the level of the ischial spines the following diameters are important:

1. The level of the sacrococcygeal platform below the ischial spines. See *H*, Fig. 2*B*. (This represents the vertical height between the plane of the spines and the plane of the sacral tip.)
2. The posterior sagittal diameter of the plane of the sacral tip. (See Fig. 2*B*.)
3. The interspinous diameter. Long narrow spines alone are not as significant in decreasing the available space at this diameter as when associated with an inward bulging of the ischium. (See Fig. 2*A*, *c*, *D*.)
4. The intertuberous diameter. (See Fig. 2, *C*.)

The above anatomic approach considers the pelvic cavity from inlet to outlet as a parallelogram, being as deep behind the pubis as in front of the sacrum. This means that the anterior depth of the pelvis includes both the height of the symphysis and the length of the rami.

The subpubic arch was studied in regard to the size of the arch and the length of the interspinous diameter.

It must be appreciated that the 500 cases upon which this report is based are *selected* material. During the investigation on pelvic type and the mechanism of labor, a series of consecutive admissions to the antepartum clinic were studied. In most instances, however, the roentgenologic examination was requested because the obstetrician either suspected the presence of an abnormal pelvis from clinical examination or was desirous of studying the pelvis after some form of difficulty had been encountered during labor. As a result, a statistical review of this material is not comparable to the frequency of occurrence of obstetric difficulty upon the basis of consecutive deliveries. Nevertheless, the case studies chosen serve the purpose to determine:

1. The frequency of occurrence of pelvic types in relation to the method used to effect delivery.
2. The type of pelvis and the mechanism commonly found in the successful use of certain well-recognized obstetric maneuvers with the obstetric forceps.

3. The influence of the lower sacral variations.
4. The relationship of the use of poor mechanics during delivery to stillbirth.
5. The question of disproportion between head size and pelvic size.

THE TYPE OF PELVIS ASSOCIATED WITH VARIOUS METHODS OF DELIVERY

The frequency of occurrence of pelvic types in regard to the method employed for delivery is shown in Table I. The most significant fact revealed by this table is the decrease in gynecoid forms and the marked increase in android forms from the spontaneous to the cesarean section group. The efficiency of the anthropoid pelvis is demonstrated by the decrease in incidence of this type and its borderline forms from the spontaneous to the cesarean section group. In 500 cases four rachitic flat pelves were noted, all in the cesarean section group.

Average measurements on a group of anthropoid, gynecoid, or flat pelvic types will show a ratio between the anteroposterior and the widest transverse diameters which indicate a long narrow oval, a round, or a transverse oval shape. The characteristic wedge-shaped appearance of the android type, however, is not shown by the ratio between these diameters. Accordingly, in this study, no attempt has been made to compute average measurements, since the results would not be significant in revealing pelvic shape.

TABLE I. DISTRIBUTION OF PELVIC TYPES ACCORDING TO THE METHOD OF DELIVERY

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	GYNECOID	ANDROID	ANDROID GYNECOID	GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	RACHITIC FLAT	NUMBER OF CASES
Spontaneous	10	15	9	37	10	8	5	4	2	0	100
Low forceps	16	15	10	32	16	5	3	2	1	0	100
Low midforceps	13	10	12	12	21	14	5	9	4	0	100
Midforceps	12	2	12	15	35	9	6	8	1	0	100
Cesarean section	11	5	9	12	41	7	3	6	2	4	100
Total											500

The smaller the pelvis, the greater is the chance of obstetric difficulty. This well-known fact is evident in Tables II to VI which show an increased frequency of small diameters from the spontaneous to the cesarean section group. But this high frequency of occurrence of small diameters in low-medium and medium forceps cases shows that small diameters do not preclude the possibility of safe delivery through the natural passages. Safe delivery, under such circumstances, may depend upon the efficiency of the forces of labor or the use of mechanical skill in operative deliveries when the pelvis is abnormal. It is for this reason that interest is directed toward pelvic shape in relation to recognized obstetric maneuvers.

Tables II to VI also show that pelves of various types may be associated with a small pelvic diameter. Flat pelves with an anteroposterior diameter of 10 cm. are commonly found in the spontaneous

and low forceps group. Certain android, gynecoid, anthropoid-gynecoid, or android-anthropoid types may, however, have an equally narrowed anteroposterior diameter but may require medium forceps or cesarean

TABLE II. DISTRIBUTION OF SMALL DIAMETERS ACCORDING TO PELVIC TYPES IN 100 CASES OF SPONTANEOUS DELIVERIES OF THE AVERAGE SIZE CHILD (3,200 GM.)

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPELLOID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
A.P. diameter of 10 cm.	0	0	0	0	0	1	2	0	1	4
A.P. diameter under 10 cm.	0	0	0	0	0	0	0	0	0	0
Interspinous diam. of 10 cm.	4	2	2	1	2	2	0	0	0	13
Interspinous diam. under 10 cm.	3	0	2	0	0	0	0	0	0	5
Transverse less than 12 cm.	2	0	0	0	0	0	0	0	0	2

TABLE III. DISTRIBUTION OF SMALL DIAMETERS ACCORDING TO PELVIC TYPE IN 100 CASES OF LOW FORCEPS DELIVERIES

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPELLOID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
A.P. diameters of 10 cm.	0	0	0	0	0	0	2	2	0	4
A.P. diameters under 10 cm.	0	0	0	0	0	0	0	0	1	1
Interspinous diameter of 10 cm.	5	2	4	1	0	6	0	0	0	13
Interspinous diameter under 10 cm.	6	2	1	0	1	4	0	0	0	14
Transverse less than 12 cm.	3	1	1	0	0	1	0	0	0	6

TABLE IV. DISTRIBUTION OF SMALL DIAMETERS ACCORDING TO PELVIC TYPES IN 100 CASES OF LOW MIDFORCEPS DELIVERIES

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPELLOID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
A.P. diameters of 10 cm.	0	1	0	2	0	0	2	3	1	9
A.P. diameters under 10 cm.	0	0	0	0	0	0	0	2	0	2
Interspinous diameter of 10 cm.	4	4	1	4	1	5	1	3	0	23
Interspinous diameter under 10 cm.	5	3	6	2	0	7	1	1	0	25
Transverse less than 12 cm.	5	3	3	1	0	0	0	0	0	12

section to effect delivery. The same principle is noted when a small interspinous diameter is compared to pelvic type and the method employed for delivery. Certain anthropoid types with a small interspinous diameter are found in the spontaneous and low forceps groups. But the android pelvis is commonly associated with an equally narrowed

TABLE V. DISTRIBUTION OF SMALL DIAMETERS ACCORDING TO PELVIC TYPE IN 100 CASES OF MEDIUM FORCEPS DELIVERIES

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPelloID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
A.P. diameters of 10 cm.	0	0	1	1	0	2	1	3	0	8
A.P. diameters under 10 cm.	0	0	0	1	0	0	1	0	0	2
Interspinous diameter of 10 cm.	2	2	3	3	4	9	0	1	0	24
Interspinous diameter under 10 cm.	4	1	5	3	0	8	0	0	0	21
Transverse less than 12 cm.	5	0	2	0	0	1	0	0	0	8

TABLE VI. DISTRIBUTION OF SMALL DIAMETERS ACCORDING TO PELVIC TYPES IN 100 CASES OF DELIVERY BY CESAREAN SECTION*

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPelloID				NO. OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	RACHITIC FLAT	
A.P. diameter of 10 cm.	0	2	2	1	3	8	1	2	0	0	19
A.P. diameter under 10 cm.	0	0	0	0	1	7	0	4	0	4	16
Interspinous diameter of 10 cm.	2	0	2	1	3	12	0	2	0	0	22
Interspinous diameter under 10 cm.	7	2	4	0	3	15	0	0	0	0	31
Transverse under 12 cm.	6	1	2	0	1	5	0	0	0	0	15

*In Tables II to VI the increased frequency of narrow diameters from the spontaneous to the cesarean section group indicates that the pelvis also decreases in size. In the tables many pelvises had more than one small diameter.

interspinous diameter in the medium forceps and cesarean section groups. In anthropoid types the long anteroposterior diameter may compensate for the narrow interspinous diameter, but in android types there is less compensatory space in the sagittal plane or in other regions of the pelvis. These observations show that as pelvic form is so variable any single small diameter is not an index of pelvic capacity. We believe the visual study of stereoroentgenograms represents the best method to employ in the examination of the pelvic architecture, since the narrowest diameter can be seen and measured and the compensatory space can be noted in other diameters.

CLASSIFICATION OF FORCEPS DELIVERIES IN RELATION TO THE MECHANISM OF LABOR

Forceps deliveries are usually classified as low, medium, or high, but each obstetric clinic as a rule makes use of a terminology of its own to designate intermediate types, as, for instance, "low-medium," "high medium," "medium forceps head within the cervix," or "medium forceps with the head partially through cervix."

In this study forceps deliveries are classified as low, low-medium, and medium in type. The high medium forceps delivery was rarely used. On the few occasions (two) in which delivery was effected from this high level, the cases were placed in the medium forceps group.

In the low-medium forceps, arrest occurs on the pelvic floor occasionally with a small amount of caput in sight or with the pelvic floor bulging slightly with each uterine contraction. At this low level the head, as a rule, shows maximum flexion and molding. As a result, anterior rotation, manually or with forceps, can be more easily carried out than at higher levels in spite of the shape of the pelvis. In medium forceps the leading part of the fetal cranium has descended to or slightly below the level of the ischial spines. At this level flexion and molding are usually incomplete. As a result the shape of the upper pelvis, in most instances, exerts its maximum influence in maintaining the original position of arrest and will resist attempts at anterior rotation.

Upon the completion of the study, however, a slight modification of this classification seems indicated, especially if roentgen methods of examination are used to study the mechanism of labor.

In previous reports^{4, 5} it has been pointed out that in certain instances the head may descend through the posterior pelvis close to the sacrum, through the center of the pelvis, or through the anterior pelvis close to the symphysis. The position assumed by the head in its descent depends to a certain extent upon the shape of the particular part of the pelvis through which it passes (Fig. 3). During this investigation no attempt has been made to determine the frequency of occurrence of these axes of descent. But, in the spontaneous and the forceps group numerous instances were noted to show that in inefficient labor in an abnormal pelvis the head descends through the more ample posterior pelvis. In low-medium and medium arrest of the head, the proximity of the head to either the sacrum behind or symphysis in front has complicated the mechanism of forceps delivery. Granted that the axis of descent may guide the head close to the symphysis or to the sacrum, it follows that arrest may occur with the head close to the symphysis in one case or closer to the lower sacral region in another. For this reason it is suggested that, when the position of arrest in relation to the symphysis or sacrum can be accurately ascertained by clinical or roentgenologic methods of examination, the type of forceps operation be classified as "low-medium or medium forceps through anterior pelvis" or "low-medium or medium forceps through the posterior pelvis" or by the use of some other equally descriptive term (Fig. 4, A).

With arrest of the head in the transverse position, anterior rotation brings about a mechanical advantage only if the shape of the upper pelvis will allow rotation, or if anterior rotation is advisable from the standpoint of the shape of the pelvis below the level of arrest (Fig. 4B). The act of anterior rotation brings the occiput into the fore pelvis and simplifies the subsequent forceps delivery.

Most experienced obstetricians have encountered cases in which anterior rotation by manual or instrumental methods is difficult or im-

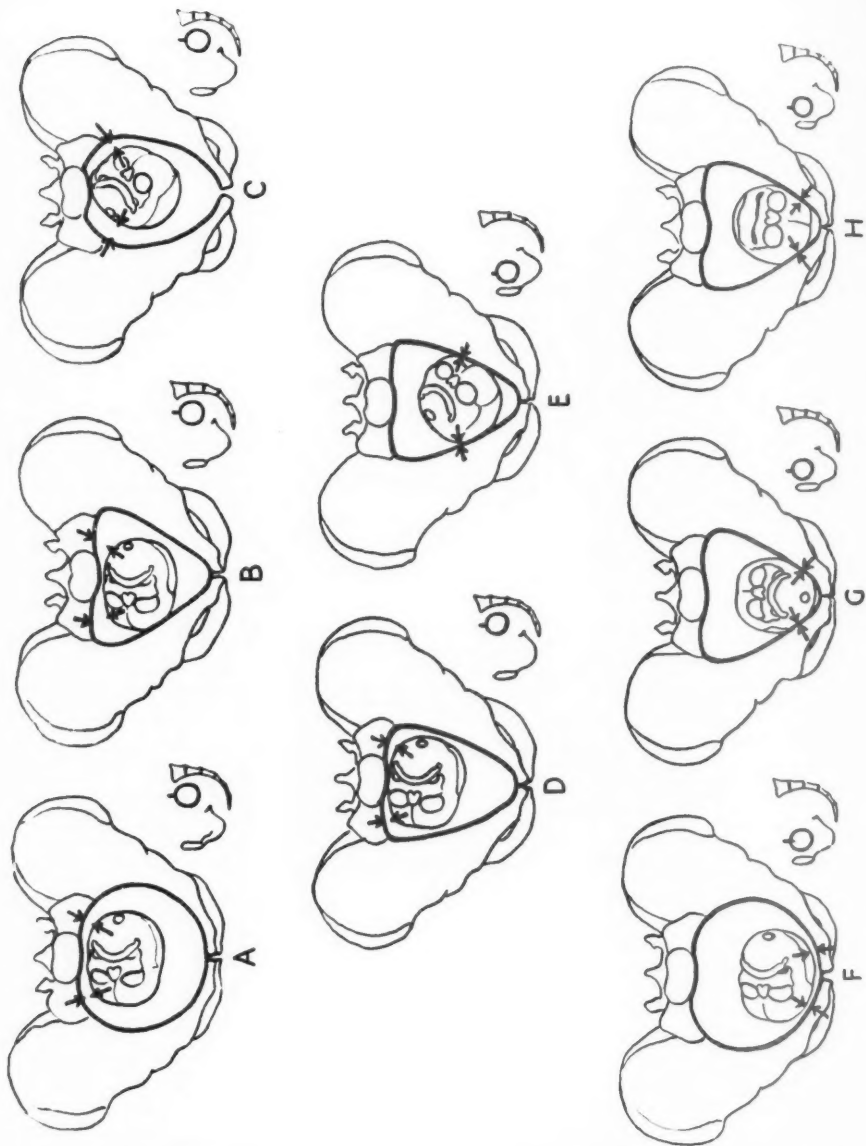


Fig. 3.—Adaptation of fetal head to pelvic shape for variable axes of descent. *A*, Transverse position in gynecoid and platypelloid types caused by the shape of the posterior pelvis as the head descends in an axis through the posterior pelvis. *B*, Adaptation of head to transverse position in the android type for the same reason. *C*, Adaptation to the occipitoposterior position or the oblique anterior position in anthropoid type for the same reason. *D*, Adaptation of the head to the transverse position in the android-anthropoid type as head descends through posterior pelvis due to the flat posterior segment. *E*, Adaptation of the head to an occipitoposterior position (or anterior position) as the head descends through axis in the fore pelvis in the androidanthropoid type. *F*, Adaptation of the head to a transverse position with descent through the fore pelvis in pelvis possessing a wide angle at the inlet (retropubic angle). *G*, Adaptation of the head to an anterior position in a narrow fore pelvis when the head descends through the anterior segment. *H*, Adaptation of the head to a posterior position in a narrow fore pelvis when the head descends through the anterior segment. As a result of these principles of head adaptation, the obstetric position of the head after engagement has occurred may be quite different from the position which existed before the onset of labor. (Courtesy of Am. J. Roentgenol.)

possible to obtain. Numerous maneuvers may be used with success, such as pelvic application of forceps to the transverse position, oblique application, a cephalic application of Kielland forceps, or version and breech extraction. In skilled hands good results are obtained by any of these maneuvers. In our clinic, however, we have been favorably impressed by the use of Barton forceps in the treatment of transverse

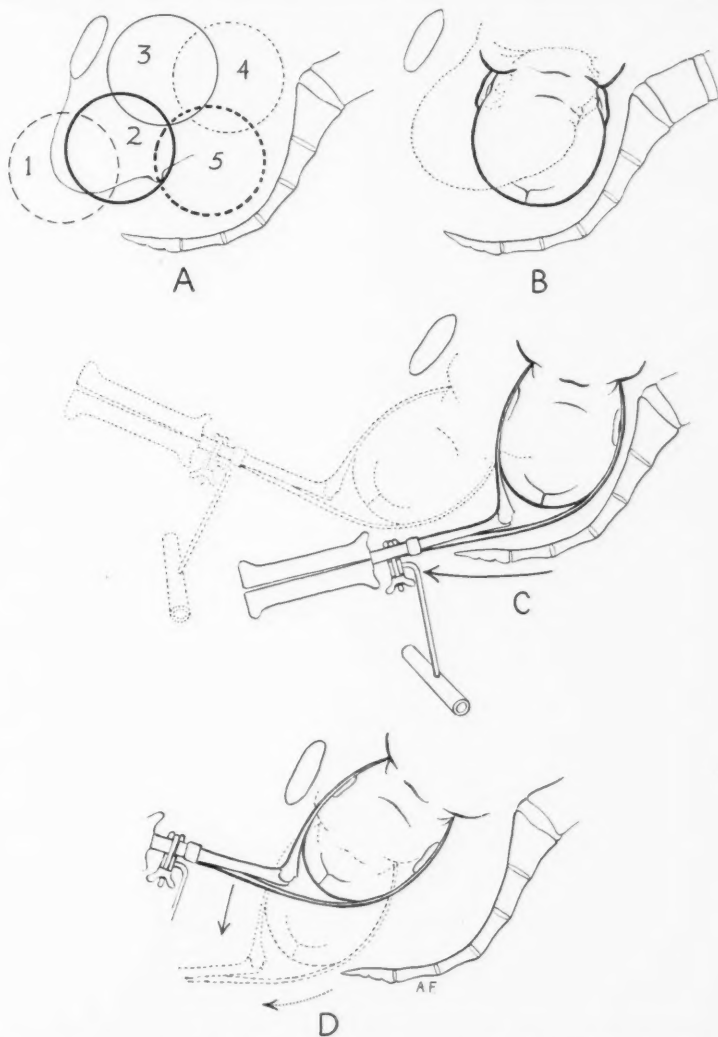


Fig. 4.—A, Classification of forceps from the standpoint of level of arrest. 1, Low forceps; 2, low-medium in the anterior pelvis (in front); 3, low-medium in the posterior pelvis (behind); 4, medium in the anterior pelvis (in front); 5, medium in the posterior pelvis (behind). B, This diagram shows the mechanical advantage of anterior rotation from the transverse position. The occiput approaches closer to the symphysis in the fore pelvis. C, Arrest of the head in the transverse position in the posterior pelvis may be delivered to lower levels in the position of arrest by anterior lateral flexion. Barton forceps are applicable for this mechanism. The head is made to follow closely the curve of the lower sacrum and coccyx. Anterior rotation is accomplished on the inner aspects of the pubic rami or in the subpubic arch. D, Arrest of the head close to the posterior aspects of the symphysis and pubic rami may occur. Forceps may be difficult to apply. The head must be first deviated slightly downward and backward as illustrated, and later laterally flexed as in Fig. 5, D.

arrest of the head (Fig. 4C). Barton forceps may be used to rotate the head at the level of arrest or to effect descent to lower levels in the position of arrest. If it is desirable to bring the head to a lower level (low-medium or medium forceps head in posterior pelvis *behind*) (Fig. 4A, 3, 5), the head is made to descend by lateral flexion following the curve of the lower sacrum and sacrococcygeal platform. By this act the influence of the posterior pelvis is removed and anterior rotation can be easily accomplished on the inner aspects of the pubic rami or with caput in sight below the subpubic arch.

In anterior positions this principle is utilized by a downward and forward axis of traction which simulates the act of early extension of the head. In posterior positions, if the head has been delivered to lower levels as such, a downward and forward axis of traction brings it close to the symphysis and promotes flexion.

The head may become arrested close to the symphysis or pubic rami in the position designated as low-medium or medium forceps in the anterior pelvis. In these cases, manual or instrumental methods should be used first to elevate the head and then to direct it slightly downward and backward and thereby avoid misdirected force with traction against the fore pelvis (Fig. 4D). These mechanical principles are mentioned frequently in the discussion of individual case studies.

During the accumulation of the large series of roentgenologic case studies at the Sloane Hospital for Women, numerous examples were found which demonstrated to our satisfaction the importance of pelvic shape in the mechanism of labor. This material enabled us to discuss the mechanism of labor in anthropoid, android, and flat types and to describe extreme examples of descent through the fore pelvis or through the posterior pelvis. This present study was undertaken to prove in a statistical manner the correlation existing between the shape of the pelvis and the particular mechanism used to effect delivery. Accordingly, the results were tabulated in an effort to find, for illustration purposes, several types of pelvis with classical mechanisms.

TRANSVERSE ARRESTS

In 48 cases out of 100 medium forceps deliveries, the head was found in the transverse position. The type of pelvis associated with the particular obstetric maneuver employed to effect delivery is shown in Table VII. In 22 instances the delivery was accomplished by the cephalic application of forceps (commonly Barton forceps) to the transverse position with lateral flexion, descent to the pelvic floor in the same position and low anterior rotation. Two types of pelvis are characteristically responsible for the ease of this mechanism—the android with straight side walls and the flat type of pelvis (Fig. 5B). In the android pelvis, resistance to anterior rotation is offered by the flat posterior pelvis. The presence of straight side walls indicates good transverse diameters throughout the lower pelvis. Lateral flexion removes the influence of the posterior pelvis and allows anterior rotation to occur on the inner

aspects of the pubic rami or at a low level in the subpubic arch. The act of anterior lateral flexion will frequently effect actual descent without the use of strong axis traction force. Barton forceps are used to illustrate this mechanism (Fig. 5*C*, *D*, and *E*). After anterior rotation has been accomplished, Barton forceps are removed and the delivery is terminated by the cephalic application of pelvic curved forceps (Fig. 5*F*).

TABLE VII. DISTRIBUTION OF PELVIC TYPE ACCORDING TO THE MANEUVER USED IN MIDPELVIC ARREST IN THE TRANSVERSE POSITION

(48 in 100 Cases of Midforceps)

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPPELOID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
Bartons, pelvic or cephalic application in the O.T. with traction to pelvic floor followed by low rotation	0	1	1	4	2	7	2	5	0	22
Anterior rotation with forceps at level of arrest	0	1	4	0	1	4	2	0	0	12
Manual rotation to oblique anterior position with delivery by pelvic curved forceps	1	0	0	0	1	3	0	1	0	6
Spiral anterior rotation by forceps	0	0	0	1	1	5	0	0	0	7
Elevation with anterior rotation and forceps	0	0	0	0	0	0	1	0	0	1
Total										48

In the classical flat pelvis the transverse oval at the inlet is preserved throughout lower levels by means of straight side walls and an average curvature and inclination to the sacrum (Fig. 5*B*). This transverse oval shape is predisposed to a transverse mechanism throughout the pelvis, which becomes more important for ease in labor the greater the degree of flattening, provided the inlet admits the head. Less trauma to mother and child results if the head is made to descend to lower levels in the transverse position, as illustrated in Fig. 5.

The pelvis may show variable degrees and types of flattening. In the true flat pelvis the ischial spines are not conflicting. Nor are they so in the normal pelvis with slight flattening, the so-called gynecoid-flat. The same mechanism occurs in the android-flat pelvis but in this type there may be convergence of the side walls with increased prominence of the ischial spines. Prominent ischial spines may cause lateral sulcus tears if the flattening of the inlet is sufficiently marked to prevent early anterior rotation of the head in an effort to avoid the spines. Separation of the symphysis, stillbirth, a shocked infant, or serious injury to the maternal soft parts has occurred by failure to maintain this transverse mechanism through premature attempts at anterior rotation in certain android and flat pelvic types.

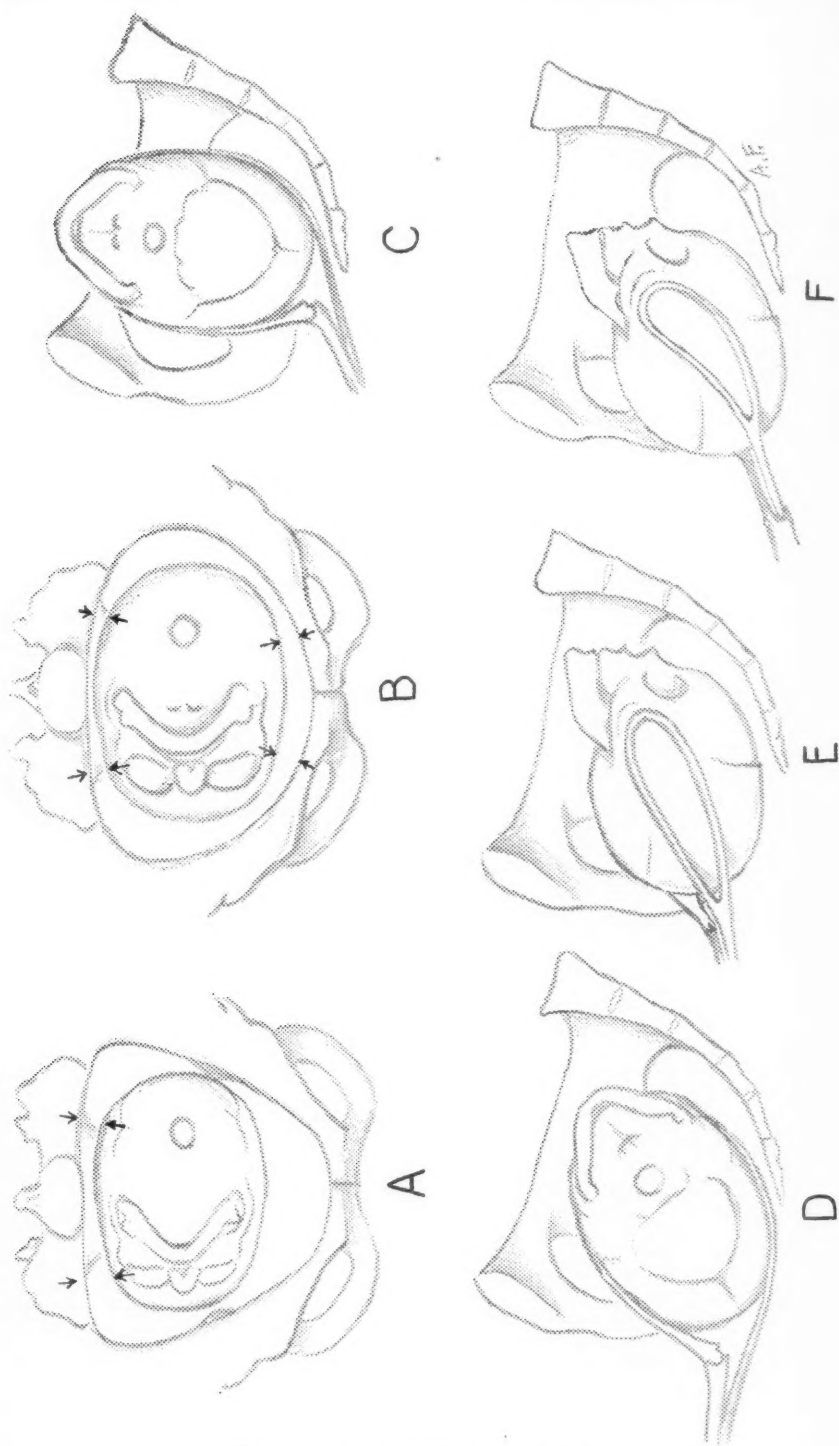


Fig. 5.—See opposite page for legend.

Table VII also shows that ease in anterior rotation in transverse arrests of the head usually indicates that there is ample space in the anteroposterior diameter to allow this rotation. There is a decided decrease in flat types when anterior rotation is accomplished by manual or instrumental rotation at the level of arrest.

This table also shows that anterior spiral rotation with descent is commonly associated with a particular type of android pelvis (Fig. 6). The inlet in characteristic android types is wedge-shaped because of the flat posterior pelvis and the narrow angle of the fore pelvis behind the symphysis. There is also a definite degree of convergence with prominent ischial spines and a narrow subpubic arch. Although architecturally the inlet cannot be considered flat, the anteroposterior diameter is usually under average in size and the narrow angle to the fore pelvis creates a flat space in the posterior pelvis through which the head descends. Thus transverse arrest at or slightly below the level of the ischial spines is likely to occur. In the operative delivery the shape of the upper pelvis acts to maintain this transverse position, while the changed shape of the midpelvis, caused by the narrow interspinous diameter, tends to encourage anterior rotation in an attempt to make use of the compensatory space in the sagittal plane at this level. Further descent in the transverse position will bring the head into contact with the restricted interspinous diameter. The correct mechanism in the event of transverse arrest in this type, therefore, consists of anterior lateral flexion associated with spiral rotation. In reality this mechanism consists of anterior lateral flexion which deviates the head toward the pubic rami and away from the posterior pelvis. After this position has been obtained, anterior rotation may be more easily carried out. Occasionally, further descent in the transverse position must be carried out when anterior rotation fails because of the influence of the posterior pelvis at the inlet. As a result, we have found several examples of android types with convergence of the side walls in which delivery was terminated by the use of Barton forceps. In these cases the Barton forceps served to flex the head laterally in the transverse position into the fore pelvis away from the influence of the posterior pelvis. The head descends to a slightly lower level in the transverse position through the widest part of the anterior pelvis in front of the narrow interspinous diameter. Anterior rotation is accomplished at a slightly higher level but according to the principle illustrated for the flat mechanism in Fig. 5. The typical android pelvis (Fig. 6), in our experience, represents the only type in which this spiral anterior rotation with descent is applicable. It is a mechanism which must be used with

Fig. 5.—The mechanism in android types with straight side walls and in the flat type of pelvis. *A*, Anterior rotation is resisted by the opposing forces between the head and the flat posterior pelvis in certain android types. *B*, Anterior rotation is resisted by opposing forces between the head and the posterior and anterior walls of the pelvis in flat forms. *C*, Barton forceps applied to the head. *D*, Descent with lateral flexion. The head follows the curve of the lower sacrum and coccyx. *E*, Anterior rotation is effected at a low level on the inner aspects of the pubic rami or under the subpubic arch after the head has been deviated away from the influence of the posterior pelvis. *F*, Barton forceps are removed and a cephalic application of pelvic curved forceps made for the low terminal delivery.

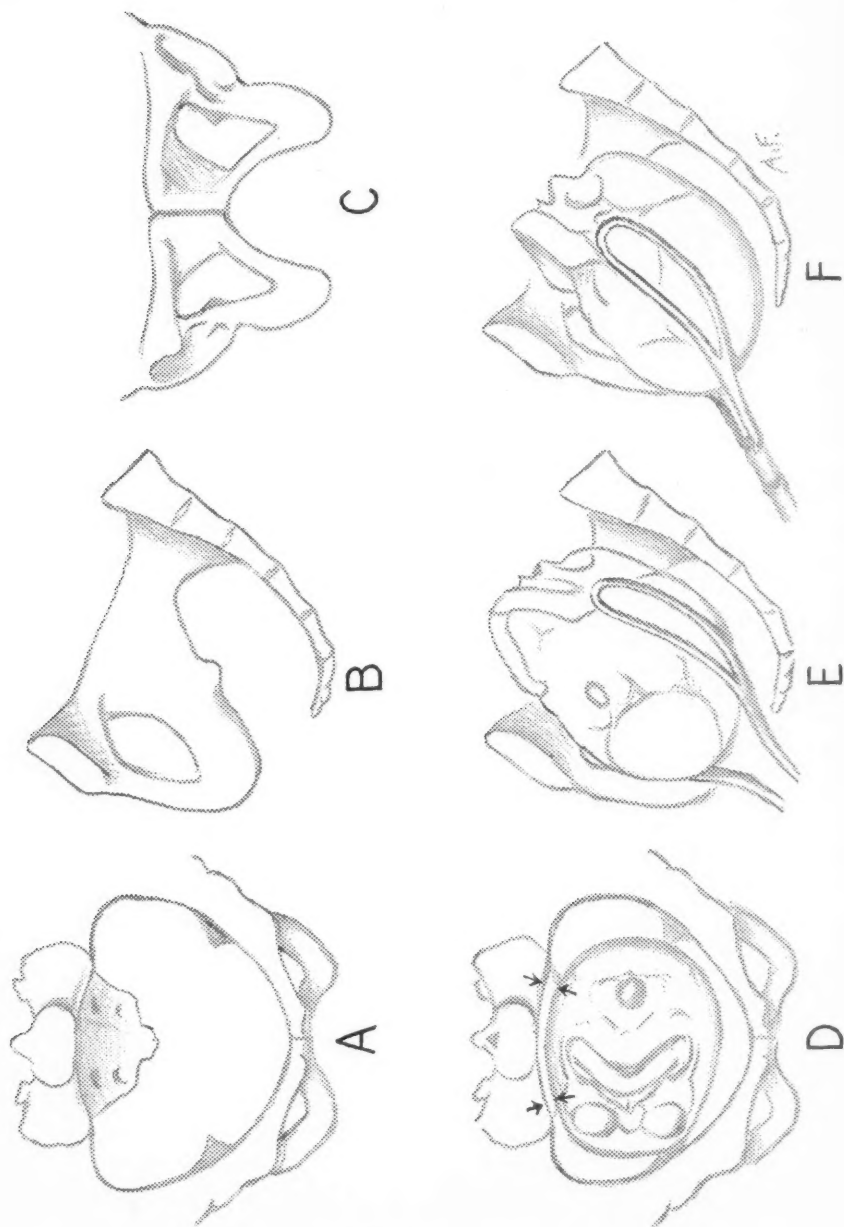


Fig. 6.—The mechanism of spiral anterior rotation in typical android types. *A*, Inlet view to show the wedge-shaped inlet with converging side walls. *B*, Lateral view to show the slightly restricted capacity in the posterior pelvis. *C*, View of the narrow subpubic arch. *D*, Transverse arrest of the head in midpelvis. The shape of the posterior pelvis prevents easy anterior rotation of the head. The narrow interspinous diameter with converging side walls below require anterior rotation, in order that the biparietal diameter may descend through the intertuberos diameter and the long axis of the head may adjust itself to the sagittal diameter. *E*, Pelvic curved forceps effect partial rotation and carry the head away from the posterior pelvis by lateral flexion. With descent, anterior rotation continues as the head moves downward and forward. *F*, Anterior rotation is now completed with the vertex low on the pelvic floor.

care. Version and breech extraction has occasionally been used to effect delivery in similar cases. It is difficult to study the mechanism in this form of pelvis because in our series such typical android types are found commonly in the cesarean section group. When spontaneous deliveries have occurred in these extreme android forms, adequate labor has molded the head and overcome any bony disproportion.

The examples shown in Fig. 5 illustrate the head close to the sacrum descending through the posterior pelvis, as in the *medium forceps behind* (Fig. 4, A). Other examples will be found in which the head

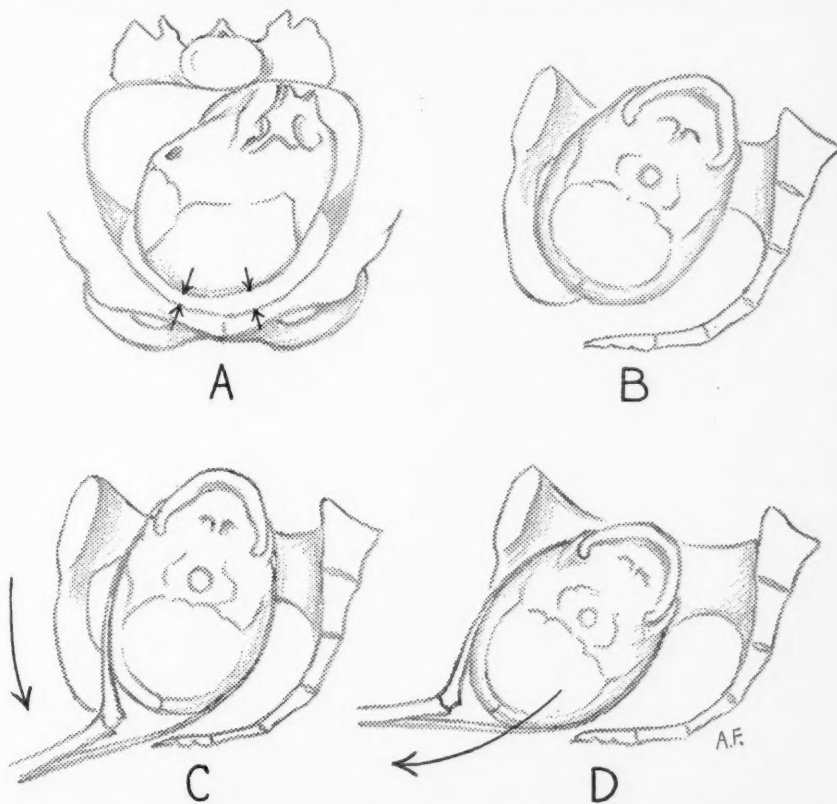


Fig. 7.—The mechanism with arrest in the fore pelvis close to the symphysis and descending pubic ram. A, Arrest in the fore pelvis in the transverse position. Anterior rotation is resisted by the flat surface of the fore pelvis. (The head may present close to the symphysis in any position.) B, Lateral view with transverse position illustrated. The lateral side of the head tends to be close to the posterior aspects of the symphysis. C, The head is dislodged upward and then slightly downward and backward by manual or instrumental methods. D, By lateral flexion the head descends into the outlet and under the subpubic arch, where anterior rotation is carried out.

descends through the fore pelvis close to the symphysis. This type of fore pelvic arrest may occur in any type of pelvis which presents a flat surface to the lateral aspects of the fetal head. The mechanism of delivery is shown in Fig. 7 in association with an android-gynecoid type of pelvis. The android-gynecoid type has compensatory space in the wide, well-formed fore pelvis. In the upper pelvis the shape of the

posterior segment creates a transverse position. If the ischial spines are long and the interspinous diameter is slightly narrowed, the head, not infrequently, descends diagonally downward and forward to pass in front of the ischial spines and utilize the wide intertuberous diameter in the lower fore pelvis. The close approximation of the lateral aspects of the head to the well-formed fore pelvis helps to maintain a transverse position to a low level. In the delivery an attempt must be made first to flex the head laterally away from the symphysis before anterior rotation may occur. In this way one avoids misdirected force with traction against the fore pelvis.

The method of delivery for the low-medium type of arrest in the transverse position and the type of pelvis commonly associated with each maneuver are shown in Table VIII. It will be observed again that when

TABLE III. DISTRIBUTION OF PELVIC TYPE ACCORDING TO THE MANEUVER USED IN DELIVERY IN LOW MIDPELVIC ARREST IN THE TRANSVERSE POSITION

(From 100 Cases of Low Midforceps)

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	ANDROID	GYNECOID	PLATYPelloID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
O.T. to floor (Barton forceps) low rotation	0	0	0	0	2	2	2	4	2	12
Rotation to O.A. Manually plus low forceps	0	0	0	1	5	2	1	0	1	10
Anterior rotation with forceps	0	0	0	1	0	3	1	1	1	7
Total										29

low transverse arrest occurs in association with the flat type of pelvis, Barton forceps are used to effect lateral flexion and low rotation. Manual rotation to the anterior position is successful if the pelvis shows compensatory space in the anteroposterior diameter. Occasionally, even in flat types, arrest may occur at a very low level after partial anterior rotation has occurred spontaneously. In these examples a cephalic application of pelvic curved forceps is made to complete the rotation.

It is interesting to note that in no instance was low transverse arrest of the head found in any pelvis possessing an anthropoid or long oval shape. Low transverse arrest in its relationship to the flat pelvis is quite analogous to the low occipitoposterior arrest of the head in relation to the anthropoid type of pelvis.

SUMMARY OF TRANSVERSE ARREST OF THE HEAD

Transverse arrest of the head is characteristically associated with either a flat or an android type of pelvis. In delivery this fact must be appreciated and the transverse position maintained to a low level. If convergence of the side walls exists, then anterior spiral rotation is advisable in android types. Success in manual or forceps rotation at the level of arrest usually implies that an ample anteroposterior diameter is present.

POSTERIOR ARRESTS

In 31 cases out of 100 medium forceps deliveries the head was found in the occipitoposterior position (Table IX). In approximately one-half of these cases delivery was accomplished by manual rotation to the transverse position followed by the application of Barton forceps. By lateral flexion and traction the head descended to a lower level in the transverse position, where anterior rotation was performed. The common pelvic

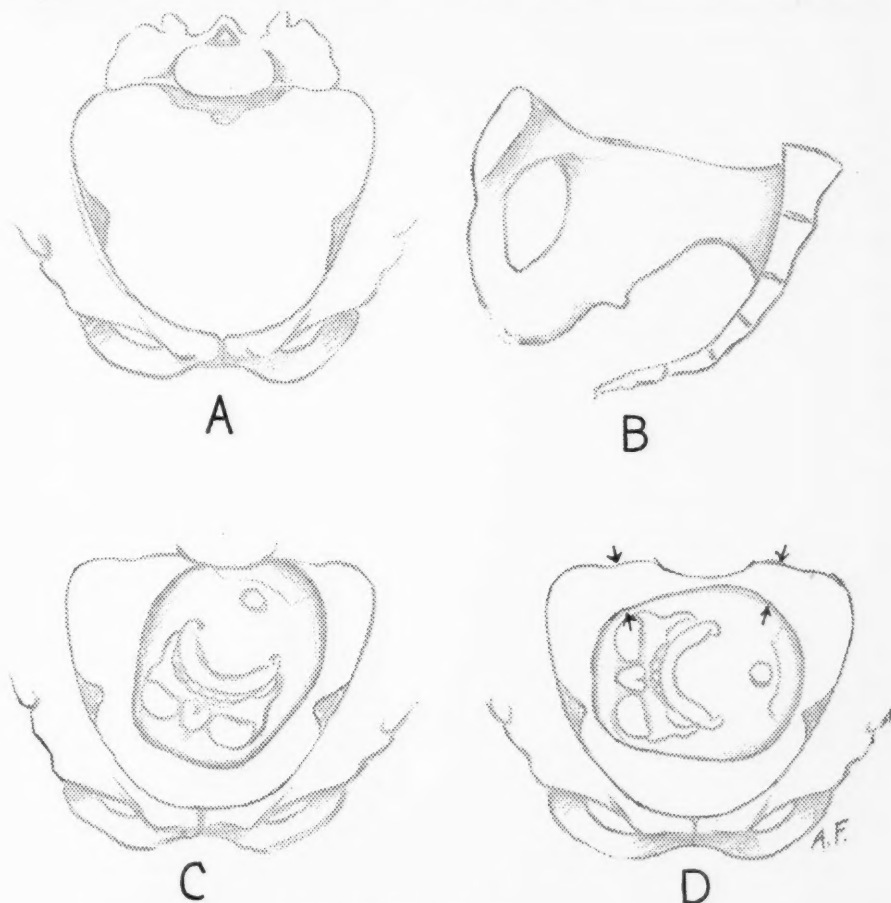


Fig. 8.—The mechanism of arrest in the occipitoposterior position in android types with slight convergence. A, Inlet view to show the shape of the inlet with slight narrowing of the fore pelvis and slight convergence of the side walls. B, Lateral view. C, Arrest in the occipitoposterior position at midpelvis. The shape of the pelvis aids in causing this position. D, The flat posterior pelvis prevents rotation of the ovoid head beyond the transverse position. From this position the delivery is usually terminated by Barton forceps as shown in Fig. 5.

type corresponded to the android form with slight convergence of the side walls (Fig. 8). The slight convergence caused the shape of the midpelvis to approach a long oval type. The flat posterior pelvis prevented complete anterior rotation beyond the transverse at the level of arrest.

A flat tendency in the pelvis was present in three cases in which it was noted that a good sacral concavity allowed the occiput to rotate posteriorly (Fig. 9). In these flat types it is obviously desirable to make use of the wide transverse diameter by rotating the head to a transverse position and by maintaining this position to a lower level. The android-anthropoid type was present in three cases in which the flat posterior pelvis resisted anterior rotation. In one extreme anthropoid pelvis, rotation to the transverse position with descent to a lower level in this position represented poor mechanics. In another extreme anthropoid

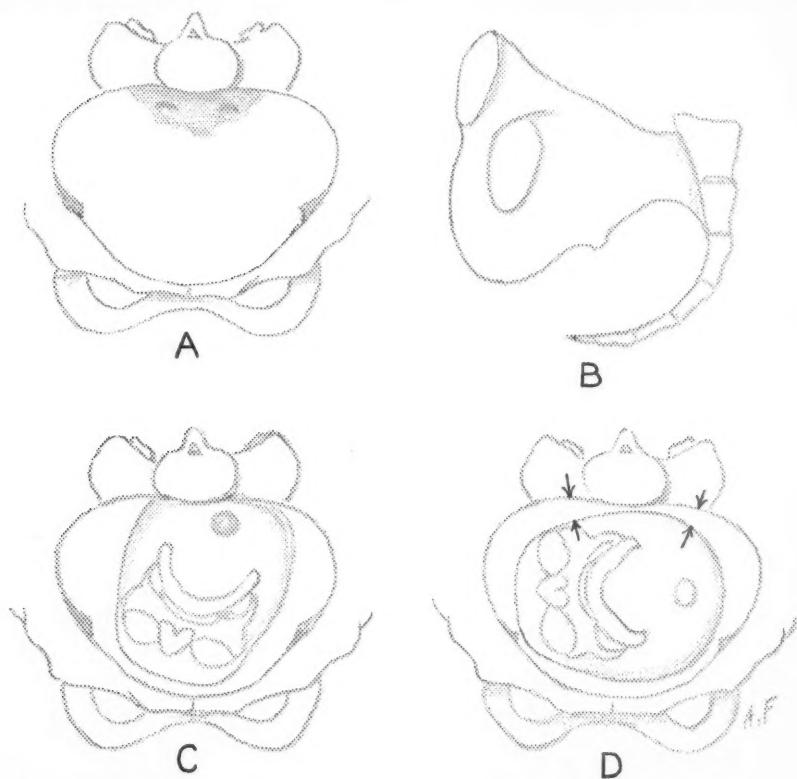


Fig. 9.—The mechanism of arrest in the occipitoposterior position in flat types with a backward sacrum. A, Inlet view. B, Lateral view to show the backward inclination to the sacrum with increased sacral concavity into which the occiput rotates. C, Arrest in the occipitoposterior position in midpelvis. D, As in the android type, Fig. 8, the posterior pelvis prevents rotation of the ovoid head beyond the transverse position. From this position delivery is usually terminated by the use of Barton forceps as illustrated in Fig. 5.

this transverse mechanism was necessary because the outlet had a flat shape owing to a markedly forward sacrum.

A Scanzoni maneuver was performed in four cases with small babies: two in anthropoid types and two in android forms. The Scanzoni's maneuver is too well known to warrant illustration. A pelvic application of forceps to the occipitoposterior position with traction to a lower level was done in four pelves, three of which were anthropoid types (Fig. 10). As a rule, convergence of the side walls is present further to pre-

TABLE IX. DISTRIBUTION OF PELVIC TYPES ACCORDING TO THE MANEUVER USED IN THE DELIVERY IN MIDPELVIC ARREST IN THE OCCIPITOPOSTERIOR POSITION

(From 100 Cases of Midforceps Deliveries)

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	GYNECOID	ANDROID	ANDROID GYNECOID	PLATYPELLOID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
Rotation to O.T. and descent to floor—low rotation	3	0	3	1	4	2	1	2	0	16
O.P. to floor—pelvic application	2	0	1	0	0	1	0	0	0	4
Face to pubis	1	0	0	0	0	0	0	0	0	1
Scanzoni at level of arrest	2	0	0	0	2	0	0	0	0	4
Manual rotation at level of arrest	0	0	0	1	0	0	0	1	0	2
Elevation with manual rotation	0	0	1	0	0	0	0	0	0	1
Spiral rotation with descent	0	0	0	0	2	0	0	0	0	2
Craniotomy	0	0	0	0	1	0	0	0	0	1
Total										31

vent anterior rotation. Descent to lower levels in the occipitoposterior position should not be attempted if the lower sacrum is forward. In one extreme anthropoid the child was delivered face to pubis.

Manual rotation at the level of arrest was successful in one case with a normal pelvis. Elevation of the head with rotation at a higher level was also employed on one occasion in an android-anthropoid type. Spiral rotation with descent was employed in two android types. Craniotomy through poor judgment was performed in one instance.

Thoms⁸ and others have drawn attention to the frequency of occurrence of the occipitoposterior position in the anthropoid pelvis. This observation, of course, is correct, but the anthropoid pelvis is an efficient pelvis, and there is usually spontaneous rotation or arrest in the occipitoposterior position at a low level with caput in sight. A study of Table IX indicates, however, that in medium forceps deliveries the arrested posterior position is found chiefly in android or in flat pelvises. The long oval shape is present at midpelvis to encourage this position by the presence of either converging side walls in the android type or a backward sacrum in the flat forms. This observation is important and stresses the value of a knowledge of pelvic shapes in the treatment of midpelvic arrest. In the low-midtype with arrest of the head in sight or on the pelvic floor, however, we find that the occipitoposterior position becomes once more characteristic of the anthropoid pelvis, as shown in Table X. Fifteen of the 22 cases showed extreme anthropoid tendencies with definite transverse narrowing throughout the pelvis. Descent of the head to the outlet usually implies good flexion and molding. Accordingly, anterior rotation is much more easily carried out than would occur if arrest took place at a higher level. Complete forceps rotation (Scanzoni maneuver) was performed six times at this low level of arrest, and in five instances the pelvis was anthropoid in shape. Elevation with manual rotation of the well-flexed and molded head was successful

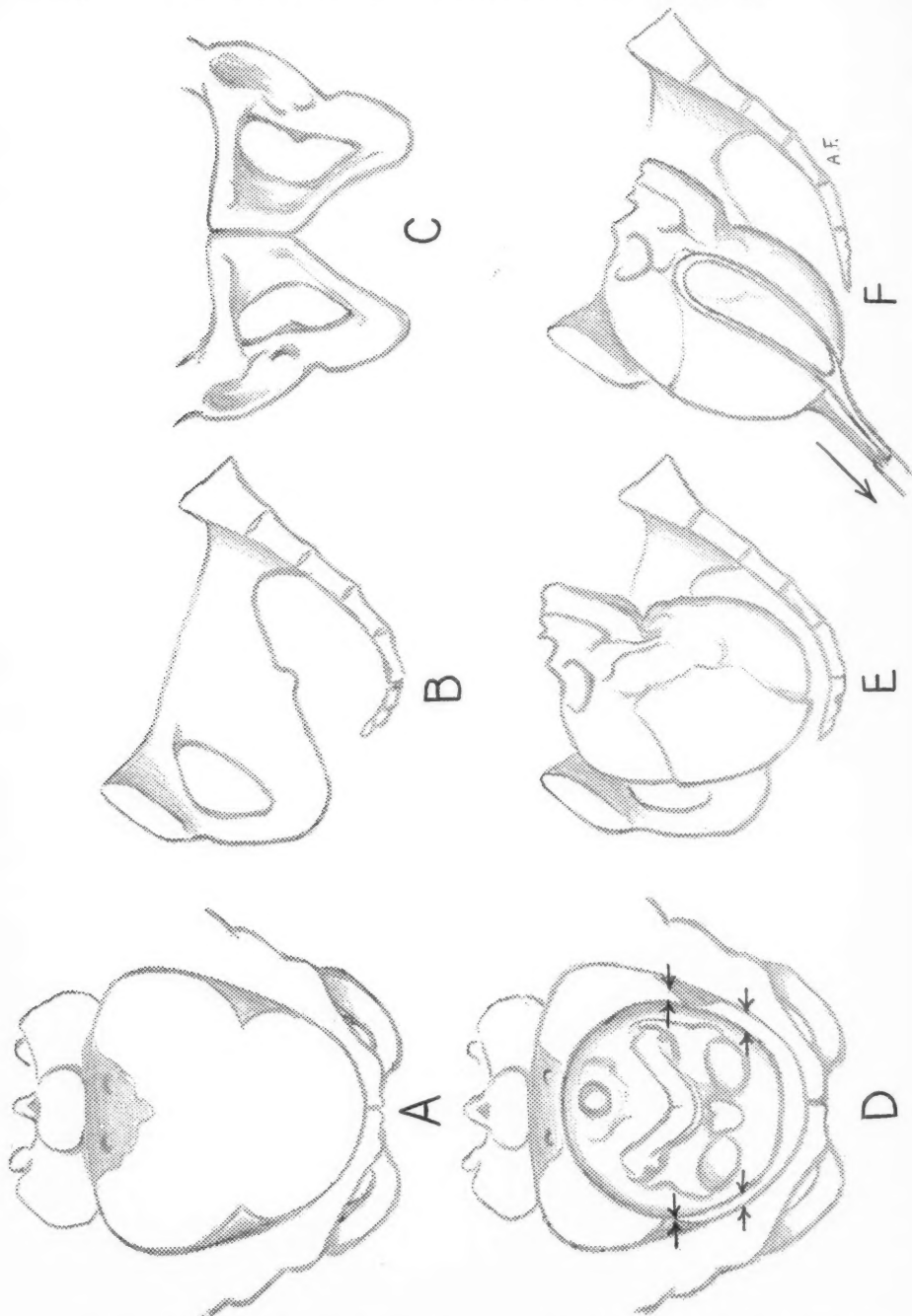


Fig. 10.—The mechanism for delivery from arrest in the occipitoposterior position to lower levels in the same position. A, Android-anthropoid type of pelvis with a long anteroposterior diameter, prominent ischial spines, and converging side walls. B, Lateral view to show ample posterior pelvic capacity because of an average curvature and inclination to the sacrum. C, Anteroposterior view of the slightly narrowed subpubic arch. D, Arrest in the occipitoposterior position, inlet view. E, Arrest in the occipitoposterior position, lateral view. F, A pelvic application of pelvic curved forceps is made and traction exerted downward and forward. A low complete rotation may be accomplished with caput in sight.

TABLE X. DISTRIBUTION OF PELVIC TYPES ACCORDING TO THE MANEUVER USED IN THE DELIVERY OF LOW MEDIUM ARREST IN THE OCCIPITOPOSTERIOR POSITION

(From 100 Cases of Low Midforceps)

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPELLOID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
Complete Scanzoni	5	0	0	0	0	1	0	0	0	6
Complete manual anterior rotation	2	1	0	2	0	1	0	0	0	6
Manual to O.T. and Barton forceps	0	0	1	1	1	0	1	0	0	4
Face to pubis	0	0	1	0	0	0	0	0	0	1
Elevation with manual rotation	2	0	1	0	0	0	0	0	0	3
O.P. to lower levels low rotation	1	0	1	0	0	0	0	0	0	2
Total										22

three times in anthropoid types. The method used commonly in mid-pelvic arrest in the transverse position was used only four times in the twenty-two cases of the low-medium type, i.e., manual rotation to the transverse position with application of forceps, lateral flexion and descent with anterior rotation with caput well in sight. Face to pubis delivery with forceps was easily accomplished in one case with a marked android-anthropoid type with convergence.

One stillbirth resulted in an extreme anthropoid type after arrest occurred with caput in sight in the direct occipitoanterior position (Fig. 11). The baby was injured by repeated attempts at anterior rotation. The successful maneuver consisted in elevation of the head to the inlet with manual rotation. This particular patient has subsequently delivered an average-sized child face to pubis spontaneously. In several of these cases a forward sacrum resulted in fracture of the coccyx.

SUMMARY OF ANALYSIS OF ARREST IN THE OCCIPITOPOSTERIOR POSITION

Arrest of the head in midpelvis in the occipitoposterior position is most frequently associated with two pelvic types: the ample android type with slight convergence and the flat type with a backward sacrum. These latter two factors (convergence or backward sacrum) create ample anteroposterior space in the midpelvis to allow the occiput to rotate posteriorly. Incomplete flexion and molding of the head favor the maneuver of manual rotation of the head to the transverse position with the application of Barton forceps followed by lateral flexion and descent with low rotation. Arrest in more characteristic anthropoid forms has been successfully treated by a pelvic application of forceps to the occipitoposterior position with descent to a lower level and rotation with caput in sight. A Scanzoni maneuver was rarely used at the level of arrest and was successful only with a small child in an ample anthropoid form. In the low-medium arrest of the head in the occipitoposterior position the number of characteristic anthropoid forms in-

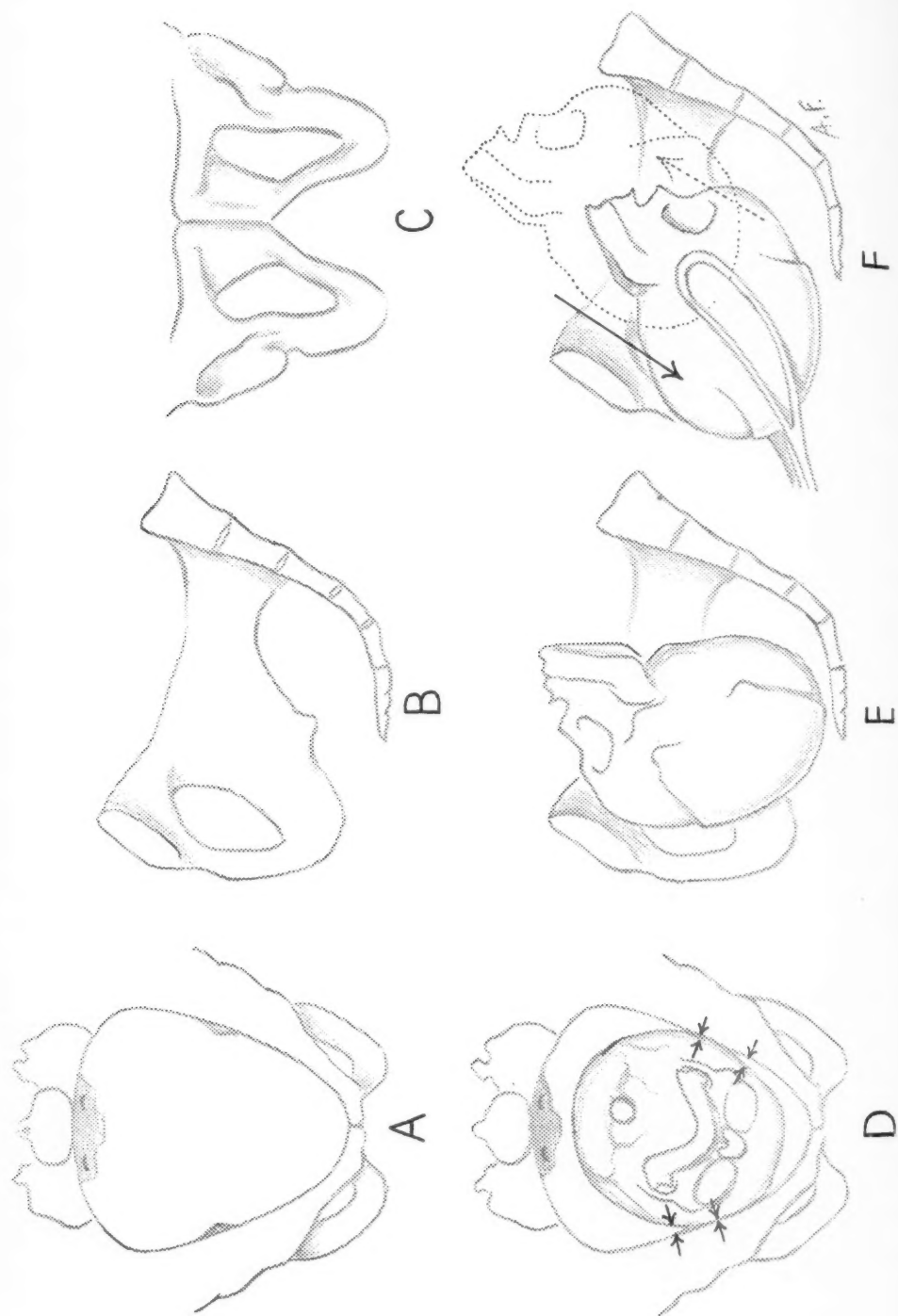


Fig. 11.—See opposite page for legend.

creases. Maximum flexion and molding of the head have allowed greater success in complete rotation by manual or instrumental methods than occurred with arrest at a higher level.

ARREST IN THE ANTERIOR POSITION

The type of pelvis associated with mid- and low-mid arrest in the anterior position is shown in Table XI. The first observation of interest is the absence of flat pelvis in the medium forceps group. This finding is in contrast to occipitoposterior midpelvic arrest in which the flat pelvis was occasionally noted in conjunction with a backward sacrum. The anterior position, however, as in the occipitoposterior arrest, is associated with two common architectural features, i.e., an ample anteroposterior diameter and converging side walls with a decrease in the interspinous diameter. The average interspinous diameter in these twenty-one cases was 10.4 cm.

With anterior arrests a cephalic application of forceps is easily made and the degree of traction necessary to effect delivery is, to a certain

TABLE XI. DISTRIBUTION OF PELVIC TYPES IN ARREST IN THE ANTERIOR POSITION FOR MID- AND LOW-MIDFORCEPS DELIVERIES

(From 100 Cases Each of Mid- and Low Midforceps)

	ANTHROPOID	ANTHROPOID GYNECOID	ANDROID ANTHROPOID	ANDROID GYNECOID	GYNECOID	ANDROID	PLATYPELLOID			NUMBER OF CASES
							GYNECOID FLAT	ANDROID FLAT	TRUE FLAT	
Midpelvic arrest in the anterior position delivered by cephalic application of forceps	3	0	5	2	4	7	0	0	0	21
Low-mid arrests in the anterior position delivered by cephalic application of forceps	3	9	8	9	4	12	0	4	0	49

extent, dependent upon the degree of convergence of the side walls. The widest biparietal diameter of the head descends through the intertuberos diameter in front of the narrowed interspinous diameter.

THE PELVIC OUTLET AS INFLUENCED BY LOWER SACRAL VARIATIONS

Convergence of the side walls and variations in sacral curvature and inclination may effect a change in pelvic shape at and below the level of the ischial spines. The importance of convergence of the side walls

Fig. 11.—The mechanism of elevation with high manual rotation in extreme anthropoid types. A, Inlet view showing a long anteroposterior diameter with marked transverse narrowing throughout the pelvis. B, Lateral view indicating a slightly forward lower sacrum. C, Anteroposterior view of the narrow subpubic arch. D, Arrest in the occipitoposterior position in the lower fore pelvis with caput in sight. Attempts at anterior rotation at the level of arrest were unsuccessful because of the restriction in transverse diameters. These attempts at rotation seriously injured the child, causing a stillbirth. E, Lateral view of arrest in the occipitoposterior position. F, Delivery was finally accomplished easily by elevation of the head toward the inlet followed by manual anterior rotation at this high level. The head rapidly descended to the outlet where low forceps were applied.

has been repeatedly stressed in a discussion of the mechanism of forceps deliveries in the android and anthropoid types.

In the sagittal plane variations in the curvature and inclination of the sacrum affect the relationship of the lower sacrum and sacrococcygeal platform to the ischial spines and change the shape of the pelvic outlet. The frequency with which the forward sacrum was noted in the low-medium and medium forceps groups indicates the influence that restriction of posterior outlet space plays in pelvic arrest. An attempt has been made to illustrate the common types of lower sacral variation by the use of suitably chosen case studies.

In Fig. 12, *A*, *B*, and *C*, the lower sacrum curved forward to a considerable degree below the level of the ischial spines. The long posterior sagittal diameter at the level of the spines and the generally large pelvis allowed rapid descent until the head was arrested by the forward sacral tip. The shape of the outlet has been converted into a flat transverse oval which necessitates the delivery of the head to a lower level in the transverse position by forceps as illustrated.

In the example shown in Fig. 12, *D*, *E*, and *F*, a somewhat similar shape was formed at the outlet. The pelvis conforms to a large flat type which predisposes to a transverse arrest. The good sacral concavity and ample posterior sagittal diameter at the level of the spines allowed the head to descend to be arrested by the forward sacral tip. It was necessary to deliver the head in the transverse position through the fore pelvis until the biparietal diameter had passed the sacral tip before anterior rotation could be obtained. Barton forceps were used to flex laterally the head over the pelvic outlet close to the pubic rami. Barton forceps, however, failed to bring about descent because force, with traction, was misdirected against the pubic rami. After a cephalic application was obtained by pelvic curved forceps, the correct downward and forward axis of traction was determined, and the head descended in the direction indicated in the diagram (Fig. 12, *D*, *E*, and *F*).

The example shown in Fig. 13, *A*, *B*, and *C*, reveals the significance of increased posterior outlet space caused by a straight sacrum with a slightly backward inclination. The pelvis, a flat android, allowed the head to descend in the R.O.T.-R.O.P. position until the posterior aspects of the perineum began to bulge. The shape of the pelvis prevented rotation but the adequate posterior pelvic shape caused by the straight back-

Fig. 12.—*Significance of sacral variations.* *A*, Lateral view of a large anthropoid pelvis with a forward lower sacrum. The posterior sagittal diameter at the level of the spines is long. The sacrococcygeal platform is elevated toward the level of the spines. The sacral tip and coccyx extend forward under the spines causing a short anteroposterior diameter at the outlet and a flat outlet shape. *B*, Arrest of the head in the transverse position on the sacrococcygeal platform. The posterior parietal bone is depressed. *C*, Barton forceps were easily applied. The head was flexed laterally toward the outlet and anterior rotation was accomplished after the biparietal diameter had passed the sacral tip. *D*, Lateral view of an ample flat type of pelvis with good sacral concavity and forward lower sacral tip. *E*, Arrest of the large head occurred on the sacrococcygeal platform close to the sacrum. The good sacral concavity allowed descent to this level. *F*, Barton forceps brought the head close to the pubic rami by lateral flexion. With traction, force was misdirected against the symphysis. Barton forceps were removed and pelvic curved forceps were applied in cephalic application. The head easily descended by downward and forward traction. Anterior rotation occurred after the biparietal diameter of the head had passed the sacral tip.

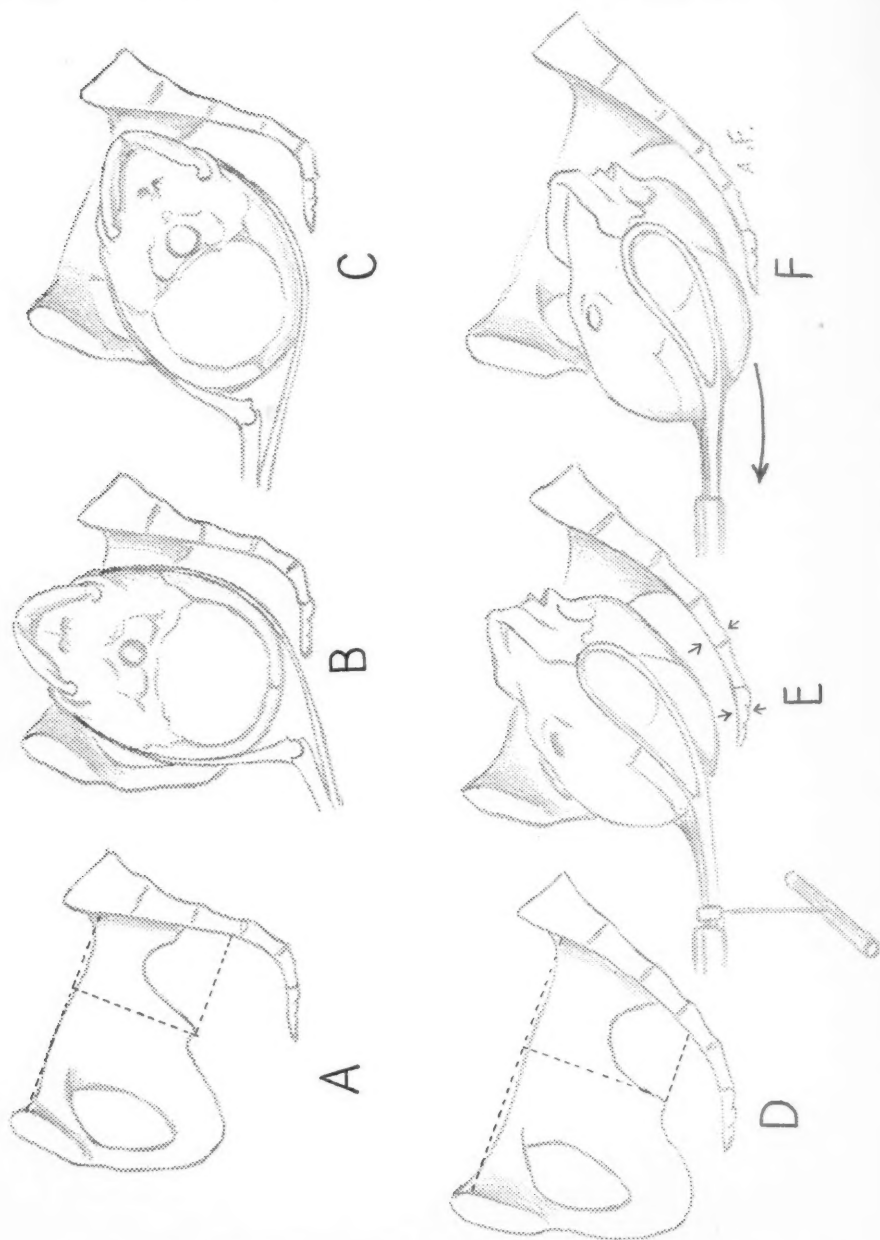


Fig. 13.—The significance of sacral variations. *A*, Lateral view of a flat android type of pelvis. The sacrum is straight with a slight backward inclination. The long posterior sagittal diameter at the level of the spines and the straight sacrum presented no obstruction to the descent of the head. Arrest occurred on the pelvic floor in the O.P.-O.T. position because the shape of the pelvis prevented anterior rotation. *B*, Lateral view of the arrest with Barton forceps applied. *C*, Lateral flexion with forceps removed the influence of the posterior pelvis and allowed low anterior rotation. *D*, Lateral view of an ample anthropoid type with a forward inclination to the sacrum. *E*, Arrest occurred just above the pelvic floor in the oblique anterior position because of the forward sacrum. Haig Ferguson forceps were applied. A downward and backward traction caused no advance of the head because traction force was misdirected against the lower sacrum. *F*, Elevation of the handles of the forceps caused slight extension of the head and with a downward and forward axis of traction, descent occurred easily.

ward sacrum allowed this low descent. The patient was delivered by low forceps. Barton forceps brought about anterior lateral flexion and anterior rotation was easily accomplished with caput in sight.

The influence of the forward sacral inclination is shown in Fig. 13, *D*, *E*, and *F*. The head was arrested in the direct anteroposterior position on the pelvic floor. Attempts at delivery with pelvic curved forceps failed when traction was exerted downward and backward. Force was misdirected against the forward sacrum. As soon as an attempt was made to extend the head, descent and an easy delivery occurred.

STILLBIRTH AND RELATIONSHIP TO THE MECHANISM OF DELIVERY

In the group of cases studied, there were 16 stillbirths. In a critical review of these cases we find that the mechanical procedures employed were open to criticism in at least 10 of them, since the correct methods of obtaining the optimum available space in the pelvis was not used. In 4 of the cases the amount of disproportion present at the time of the forceps operation was a definite contraindication to this procedure and either a cesarean section should have been done earlier in labor or, if possible, the labor should have been allowed to progress until further molding had occurred. In the remaining 2 cases, one infant died following a spontaneous delivery in which the shoulders became impacted, and another died in utero before any operative procedure was instituted. Of further interest is the fact that 5 of the women who had stillbirths subsequently delivered living children spontaneously. In 7 of the 16 cases the pelvis conformed to the extreme android form. In order to illustrate more clearly the importance of using good mechanics in delivery in an effort to avoid injury to the child and the maternal soft parts, the following 4 case studies have been chosen (Fig. 14). These 4 cases along with the example illustrated in Fig. 11 stress the following principles in mechanism:

1. Forceful attempts at anterior rotation in flat and certain android pelvic types should not be made or separation of the symphysis or stillbirth may result.
2. The transverse mechanism to lower levels should be encouraged in these forms.
3. Forceful attempts at anterior rotation in low occipitoposterior arrest in extreme anthropoid pelvis are equally dangerous.
4. The head should be elevated and rotated at a higher level or brought to a lower level in the occipitoposterior position.

During the last two years at the Sloane Hospital for Women, the attending staff have cooperated in the application of a knowledge of pelvic shape to the mechanism of labor. The incidence for cesarean section has not increased because of the better selection of cases for this method of delivery. The incidence of difficult forceps deliveries has decreased and there has been a definite decrease in the fetal mortality rate due, we believe, to the use of a better mechanism in forceps deliveries. The resident and interne staff, with instruction, readily grasp the principles of mechanism described in this report. Recently, in our clinic, there has been renewed interest in the roentgenologic study of the pelvis and fetal-pelvic relationships of patients in labor who are not progressing normally. Frequently, the recognition of a large head in a

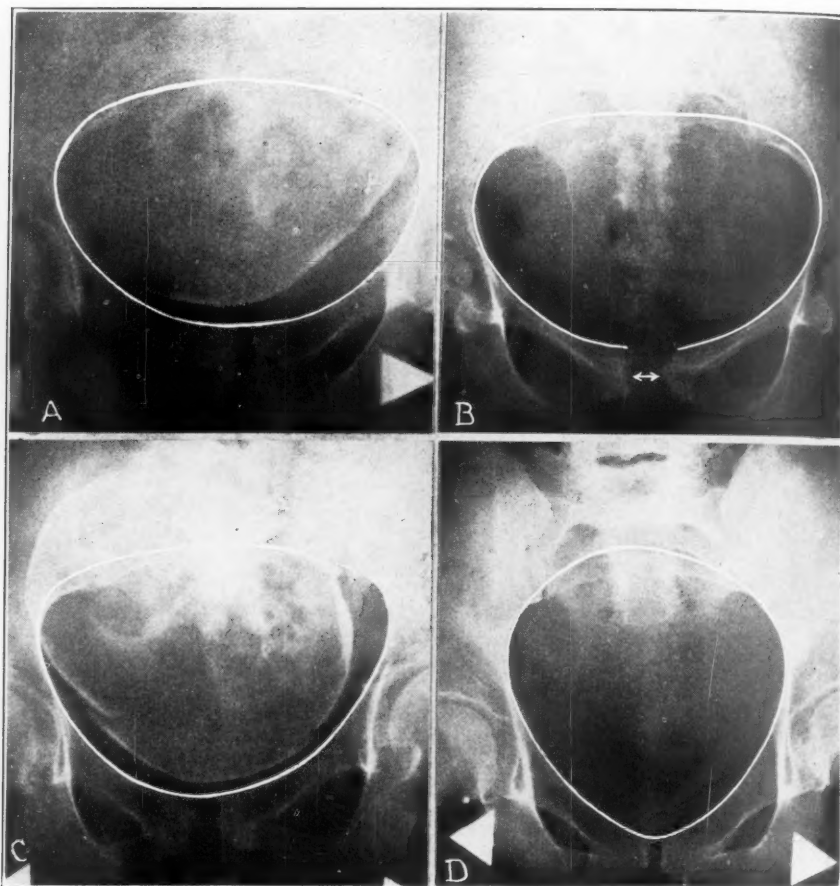


Fig. 14.—*Pelvic type and mechanism of delivery in relation to stillbirth.* A, X-ray No. 90557. Chart No. 309025. The pelvis conforms to the typical flat android type. Arrest occurred in midpelvis in the transverse position. The child was seriously injured by forceful attempts at anterior rotation with a poor cephalic application to the oblique anterior position. This type of pelvis favors the transverse mechanism described in Fig. 5. Weight of stillborn child, 3760 gm. The second child was delivered spontaneously, 4020 gm.

B, X-ray No. 89937. Chart No. 420649. (Case not included in the series of 500 cases.) The pelvis conforms to the true platypelloid type. Forceful attempts at anterior rotation of an arrested transverse position caused a separation of the symphysis and a stillbirth. The second child was delivered by cesarean section.

C, X-ray No. 164492. Chart No. 474972. The pelvis conforms to the typical android with practically straight side walls. Arrest of a large child occurred in midpelvis in the transverse position with the cervix fully dilated. Weight of child, 3856 gm. Forceful attempts were made to gain anterior rotation with pelvic curved forceps. The child died from intracranial hemorrhage twelve hours after delivery. This pelvis favors the transverse mechanism illustrated in Fig. 5.

D, X-ray No. 160792. Chart No. 300125. The pelvis conforms to the typical extreme anthropoid with straight side walls and a moderate subpubic arch. Arrest occurred in low midpelvis in the occipitoposterior position. Forceful attempts at anterior rotation were used. With difficulty the head was rotated to the transverse position and delivered to lower levels in this position with Barton forceps. This mechanism is obviously incorrect. The head should be elevated and rotated or brought to lower levels in the position of arrest. The child weighed 3610 gm. and was discharged living. It was badly shocked on delivery and suffered multiple fractures of the parietal bone.

small pelvis has aided in the decision regarding the best method of delivery during the so-called trial of labor. If a forceps delivery later becomes necessary, the operator has an opportunity to attempt the mechanism he has interpreted as representing the optimum method for delivery from the study of the roentgenograms. As a result, greater conservatism in operative obstetrics has been practiced.

THE RECOGNITION OF DISPROPORTION

Disproportion between the head and the pelvis to even a major degree is occasionally observed in spontaneous deliveries, especially in multiparous women. The incidence increases in the low forceps, low-medium, and medium forceps, and cesarean section groups. The disproportion, in most instances, can be readily observed from the study of the stereo-roentgenograms in the precision stereoscope by visually attempting to compare the head and its biparietal diameter to the available space present at the inlet or in the lower pelvis. The observer, experienced in the use of the precision stereoscope, can actually measure one or more cardinal diameters of the fetal head besides noting the amount of clearance between the head and the pelvis. Flexion and molding of the head in labor decrease head size and represent such variable factors that, in practice, attempts to reduce the degree of existing disproportion to simple mathematical terms have not given satisfactory practical results.

But during this investigation which included many case studies obtained during labor, we have been interested in methods to estimate degrees of disproportion applicable to the precision stereoscope. The first problem deals with the index of pelvic size when the shape is abnormal. We have already shown that single pelvic diameters by themselves cannot be used to denote pelvic size in all instances (Table II to VI). In abnormal pelvises the size of the circle which may be inscribed within the pelvic inlet (under stereoscopic vision) represents a good index of pelvic size since the compensatory space existing around the circumference of the circle may be observed (Fig. 15A). Likewise, in many instances, the biparietal diameter of the fetal head can be measured directly or by the aid of graduated spherical disks fitted under stereoscopic vision into the approximate level of the biparietal diameter. If the circle which fits the biparietal diameter of the fetal head is compared to the size of the circle which fits the inlet, the degree of disproportion may be calculated. In examples of absolute disproportion between the head and the pelvis, the diameter of the circle of the inlet is usually larger than the circle of the biparietal diameter by 1 to 1.5 cm.

The surface area of the head presented to the pelvic inlet in labor is variable in size depending upon the existing degree of flexion and molding. The circle of the biparietal diameter represents its smallest size when the head shows extreme flexion. Since flexion is usually incomplete, the surface area presented to the inlet by the silhouette of the head is usually larger, reaching the maximum size in brow presentations.

These factors must be considered in the visual study of the fetal-pelvic relationships in the stereoscope. But when disproportion is noted in borderline cases, a trial of labor becomes the best means for determining the correct significance to place upon this supposed degree of disproportion.

Workers interested in methods of roentgen pelvimetry and cephalometry have attempted to use a measurable approach to the analysis of

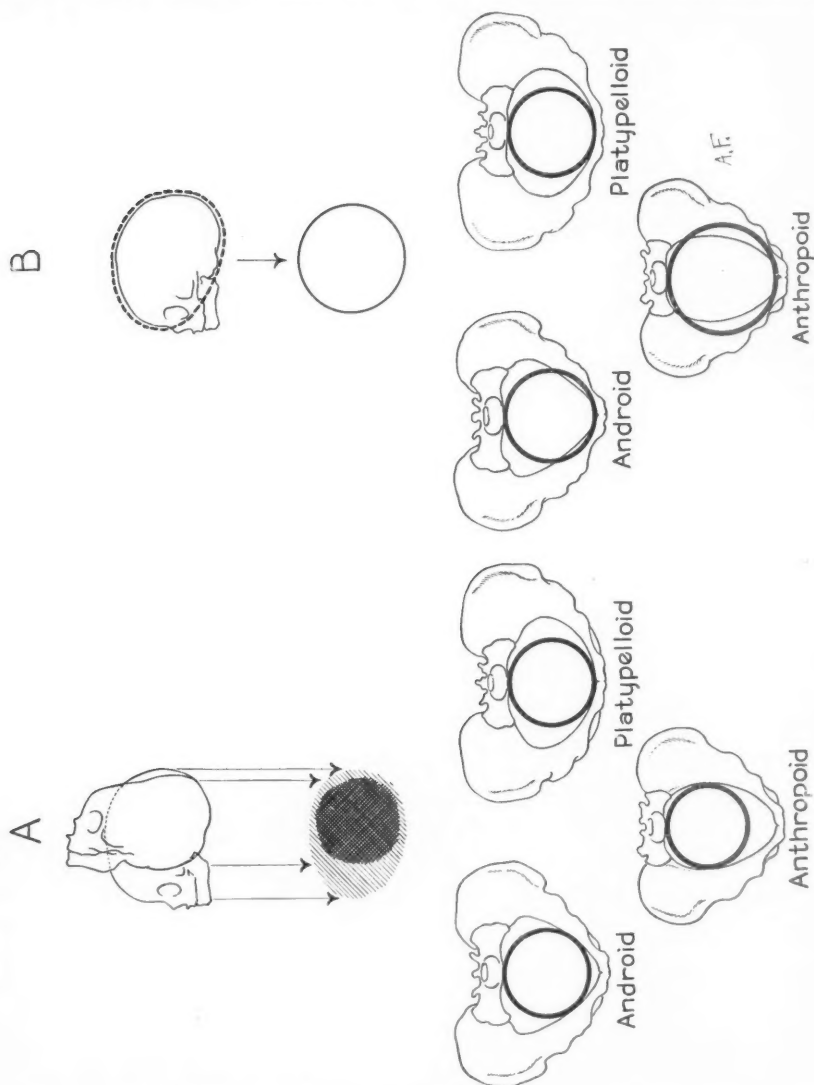


Fig. 15.—The comparison of head size to pelvic size. A, Authors' method. The surface area of the head presenting to the inlet varies from the circle of the biparietal diameter (smallest) to the circle of the occipitofrontal ovoid. The circle of the biparietal diameter may be compared to the circle inscribed within the pelvic inlet as obtained by use of the precision stereoscope. B, The method suggested by Ball and Marchbanks. The volume of the ovoid head is converted into a sphere which in turn is compared to the volume of a sphere the diameter of which equals the smallest pelvic diameter. Observe that a circle inscribed in the anteroposterior diameter in android and anthropoid types may not give the correct index of inlet size.

these borderline types. A unique method has recently been suggested by Ball and Marchbanks.⁷ The volume capacity of the fetal head is determined by the circumference measurements obtained from a single large lateral and a large anteroposterior film. The average circumference measurements are converted into a sphere, the volume capacity of which can be easily determined and recorded in cubic centimeters. It will be noted that conversion of the ovoid fetal head into a sphere enlarges the biparietal diameter for comparison to inlet diameters. The smallest inlet diameter and the interspinous diameter are chosen to associate with this spherical head volume by determining the volume capacity of the sphere with a diameter equal to either pelvic diameter. Ball has found that if head volume is 150 c.c. greater than the volume of the smallest inlet diameter the difference is too great to be safely handled by changes in head shape through molding, and a cesarean section is indicated. He has not as yet decided upon the limits of safety at the level of the ischial spines. This principle is illustrated in Fig. 15B.

By the use of the method proposed by Ball we have observed an easy delivery with a disproportion of 200 c.c. at the inlet. An easy low forceps delivery has occurred when over 300 c.c. disproportion was present between head volume and the volume of the interspinous diameter. These findings reveal the variable factors which occur in the mechanism of labor and show that, in most instances, it is not advisable to attempt to reduce the degree of disproportion to significant mathematical terms.

Accordingly, in a critical analysis of the merits of the method of volumetric head and pelvic comparison, several assumptions upon which the method is based are open to question. From the obstetric standpoint it is not advisable to convert a long oval object like the fetal head into a sphere for comparison with pelvic size. This conversion enlarges the biparietal diameter of the head above its existing size. Again, the smallest pelvic diameter is not always the proper index of pelvic size to use for comparison with head size to determine the existing degree of disproportion. The conversion of the volume of the ovoid head into a sphere places no significance upon head shape. Head shape has considerable practical significance. The question of disproportion in terms of ease or difficulty in labor remains unsolved except by clinical methods. Nevertheless, an optimistic view is justifiable and further study of a large series of cases by a modified volumetric approach and study of pelvic size when the pelvic shape is abnormal will eventually contribute accurate prognostic information.

To conclude this paper without calling attention to the fact that forceps are frequently used when the pelvis itself is adequate in size, might leave a false impression. In another study of 130 cases of midforceps operations, there were 40, or 30.7 per cent, in which the pelvis itself was ample as judged by our experience and by comparison with the types of pelvis seen in the spontaneous group. A discussion of these cases is beyond the scope of this presentation. It becomes evident, however, that a midforceps delivery cannot always be predicted on the basis of the pelvis alone. Roughly about one midforceps in three will

occur in association with an adequate pelvis. The data presented show the importance of the bony pelvis but emphasize that there are other important factors to be considered in determining the ultimate outcome of labor.*

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DISCUSSION

DR. GERALD C. MELHADO, MONTREAL, CANADA.—Dr. Caldwell states that in a series of 130 midforceps operations in 69.3 per cent the pelvis was abnormal in size or shape, or both, whereas in our clinic (Victoria General Hospital, Montreal) during the past year in 111 midforceps operations definite abnormality existed in only 20 per cent. This situation is highly contradictory. It seems to me that there must be some explanation for the wide difference in the two clinics, more deeply fundamental than that explainable by methods of classification.

That arrest of the head in midpelvis is due to other factors than pelvic abnormality is generally recognized. In our clinic soft tissue dystocia, either with or without faulty attitudes and positions is a frequent cause for forceps interference. In fact, as already stated, the majority of operations were done on women who showed no definite contraction. Disproportion between head and pelvis is not necessarily due to or associated with pelvic abnormality.

Primary uterine inertia is a common cause of arrest and in our experience is most frequently associated with a posterior position of the occiput. An internal contraction ring situated about 8 to 10 cm. above the external os and around the child's neck frequently is found in such cases. In many instances it was the chief reason for the lack of progress.

I am entirely in agreement with Dr. Caldwell's statement that the occipitoposterior position should not be rotated at the level of arrest when such positions are associated with a typically transversely narrowed pelvis. His report on case studies 6 and 7 illustrates clearly this point, and in both instances manual rotation at a higher level would, in my opinion, have been successful and less likely to cause injury. That this is probably so was shown by the fact that in one of these cases in a subsequent delivery, spontaneous birth occurred from the L.O.A.

As a general statement, I am of the belief that if arrest of the head occurs in a given pelvis in the O.T. or O.P. position, rotation if considered advisable should be done at a different level and preferably free from pelvic control. Forceps rotation at the level of arrest accompanied by or with traction is dangerous, and is likely to result in severe injury.

In conclusion, there is a type of case of which no mention has been made, but which I understand will be considered in the published paper. This concerns the large head in the small pelvis considered by Dr. Caldwell as a slightly flat android type or in other classifications might be called generally contracted and somewhat flat. The possibilities for live births in this group depend upon many factors: efficient uterine force, moldability of the head, length of cervix, the presence or absence of a well-formed lower uterine segment and the type of sacrum. Uterine force and moldability of the head cannot be determined before labor. A short cervix and a well-formed lower uterine segment are favorable factors. A

*This investigation has been made possible through the cooperation extended by Dr. B. P. Watson and the attending and resident staff of the Sloane Hospital for Women and by Dr. Ross Golden and Dr. Paul C. Swenson of the Roentgen-Ray Department of Presbyterian Hospital. The authors take this opportunity to express their deep appreciation.

straight sacrum associated with this type of pelvis carries with it a greater degree of contraction in the pelvis than can be usually estimated. Reliance should be placed on experience and judgment. If disproportion at the brim is evident, the sacrum straight, and the head cannot be made to enter the pelvis fairly readily under anesthesia, it might be advisable to put this group in the elective cesarean class.

DR. BENJAMIN P. WATSON, NEW YORK, N. Y.—As I have followed the work of Dr. Caldwell and Dr. Moloy on the female pelvis I have become more and more convinced of its fundamental value. In the last two years they, along with Dr. D'Esopo, have been stressing the practical application of their findings. They have established the fact that pelvic configuration is largely responsible for the mechanism of labor in a particular case; that the mechanism can be predicted from a roentgenologic study of the pelvis; and that when delay in labor occurs the difficulty can be overcome in a rational way if one knows the type of pelvis, for then one may make use of its best available diameter. To arrive at this stage in their work they have had to spend much time in examining and interpreting many x-ray films taken before and during labor. Moloy's precision stereoscope is fulfilling all that was expected of it. One very quickly learns how to use it and having used it one is never satisfied to do without it in a difficult case.

The treatment of the occipitoposterior has been the subject of as much discussion as any other obstetric complication in our literature. From Scanzoni down to DeLee, Pomeroy, and Bill, different methods of handling this complication have been advocated. The present work of Dr. Caldwell and his associates would seem to indicate that while all of these various techniques have merit in selected cases, no single method is universally applicable to all cases. The midpelvis is much too variable in shape to make any single operative method the solution for all arrests of this sort. Of course, we all know that the well-trained obstetrician does not rigorously adhere to any one method but rather feels his way carefully as he goes along and by artfully modifying his favorite method is enabled to guide the head away from bony obstruction into the most available diameters. This, however, requires experience. Only after years of practice and perhaps many errors does the obstetrician acquire the so-called art of obstetrics which enables him to carry on in this way. Precise methods of evaluating the available space in the pelvis converts at least a part of this "art" into demonstrable and predictable facts which may be taught as such to the student of operative obstetrics. Granted then that the expert in most instances is able to carry out operative deliveries to the best advantage of both mother and baby without recourse to the refinements afforded by the x-ray, its value in teaching obstetrics cannot be overestimated.

DR. CALDWELL (closing).—I was rather surprised to find that in practically 70 per cent of our midpelvic arrests we found abnormality in the shape of the pelvis. The uterine contractions in these cases were weak and the labor pains inefficient, due to the shape of the pelvis, the lower uterine segment not permitting the presenting parts to fit squarely into the axis of the cervix. When this happens, it is not guided away against the anterior or posterior wall.

The majority of cases of stillbirth were due to so-called fetal distress. Personally I think it is a very great mistake to apply forceps hastily when the child is showing fetal distress and kill it by trauma. It is much better to put the presenting part up, relieve the uterine contraction if necessary, and then plan the operative delivery after the child has plenty of oxygen and the fetal heart is relieved. The woman may then continue the delivery herself.

THE CESAREAN SCAR*

AN EXPERIMENTAL STUDY

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IN THE earlier editions of Williams' *Textbook* the statement is made in discussing the phrase "once a cesarean always a cesarean," that this is based in part upon the belief that the uterine incision heals by the formation of scar tissue, whence the term "ciatrix," and the newly formed connective tissue stretching and sometimes yielding when the uterus becomes distended. That such a belief is erroneous is shown in three ways. First, an inspection of the unopened uterus at the time of repeated section usually shows no trace of the former incision. If present, it appears as an almost invisible linear scar. Second, when the body of the uterus has been amputated, no scar is visible after hardening or at most a shallow vertical furrow is present upon the external and internal surfaces of the anterior wall, while between them no trace of the scar is apparent. Third, the most important histologic examination at the site of the incision shows that the uterus, just as all other organs containing smooth muscle, heals by a regeneration of muscle fibers and not by scar tissue.

Since it is well known that smooth muscle regenerates very slowly, and that in end-to-end intestinal anastomosis, the ends of the muscles are definitely separated by the intervening healing and are brought together eventually by the shrinking of the scar, Schwarz and Paddock felt this could also be demonstrated in the uterus experimentally.

In 1925, Schwarz and Paddock described the healing process in the early human uterus and clearly demonstrated the laying down of fibrin and fibroblasts along the line of incision in the early process of healing. These observations were followed by a series of experiments on the uteri of pregnant guinea pigs at term. This work conclusively showed that the process of healing was by scar tissue formation. In the early stages the marked development of fibroblasts could be seen along the line of incision, penetrating the cut muscle bundles very much like the limbs of a tree. As early as twelve days, in ordinary hematoxylin and eosin sections, it was difficult to demonstrate the line of incision, because of the intimate intermingling of cut muscle edge with fibroblastic proliferation.

In the sixth edition of Williams' *Textbook* the previously mentioned statements still appear, with the addition that enthusiastic advocates of the low cervical section contend that the rupture of the scar is less likely to follow than in the classical operation. They mention the work of Greenhill, who could demonstrate connective tissue in twenty-six instances out of thirty-one cases of low incision. They state that if this

*Read at the Sixty-Third Annual Meeting of the American Gynecological Society, Asheville, N. C., May 30 to June 1, 1938.

were the general rule it would not argue in favor of the operation as the connective tissue scar would be more liable to rupture than the muscular union which occurs after classical cesarean section. The same statements are made in the last edition of Williams' *Textbook*, published in 1937. Apparently the work of Schwarz and Paddock was overlooked as no mention of it was made under this discussion. The statement that there was scar tissue formation in the lower uterine segment and none in the upper incision seems somewhat illogical, because in both locations we are dealing with smooth muscle tissue of the same kind.

In view of these facts, we believed it might be of interest to review this subject as a whole and to present further experimental studies to emphasize these points. In 1906 the experimental work of Murphy clearly showed that so far as end-to-end intestinal anastomosis is concerned, healing takes place by scar tissue formation.

It is well known that in an end-to-end anastomosis a considerable exudate is formed along the line of suture which becomes organized as the result of marked proliferation of fibroblasts, which later contract and form an almost imperceptible scar between the muscle tissue. Descriptions and illustrations showing various stages of this process demonstrate that in the earlier stages there is marked separation of the muscle bundles, and as late as one month after, a definite linear scar, very thin, can still be made out between the edges of the muscle. These steps are particularly well illustrated in Gould's monograph on abdominal operations.

The other point concerns the regeneration of smooth muscle. It has been our opinion that smooth muscle regeneration takes place so slowly and meagerly that it could not bring about healing in so comparatively short a period of time. In our previous paper we reviewed the subject of smooth muscle regeneration and feel that it is important to include it again here.

McCallum, in his textbook on pathology, states that from experimental and other studies of the healing of defects in smooth muscle, there is very little activity in this region. Sometimes mitotic figures have been described and sometimes a new formation by amitotic division, but more recent studies tend to the idea that there is very little regeneration of muscle tissue in higher vertebrates, but that healing by scar tissue brings together the muscle edges at the site of defect. However, recent observations of Loeb and Walsh in a quantitative study on the regeneration in the uterus of epithelial, connective tissue and muscle tissue, show clearly that there is definite evidence of mitotic figures in the smooth muscle tissue as well as in the connective tissue, both after incision and compression by ligatures.

Loeb and Walsh conclude that mitosis in smooth muscle tissue is found between the fifth and eleventh days in the guinea pig, but only in specimens in which mitosis was also definitely present in the connective tissue. Also Loeb and Kuramitsu have shown that in the involution of the normal uterus in the guinea pig and rat, mitotic figures appear in smooth muscle layers during the first week of the puerperium, but are very rare after the first week.

As regards the regeneration of smooth muscle in the human uterus, the only evidence of such regeneration was described by Berry in 1922. Berry was able to demonstrate mitotic figures in the smooth muscle tissue of the uterus four days after perforation of the uterus by a curette. He found three mitotic figures on an average

in the high powered field, and as far as he is able to estimate, it is the only case on record where any question of regeneration of smooth muscle tissue is found in the human being. He was able to confirm the work of Loeb and Walsh as regards mitotic figures in the uteri of experimental animals.

The only experimental work on the uterine scar which we know of is that of Mason and Williams, which was done in 1910 on the uteri of guinea pigs. These observers did no histologic work, but merely tested the strength of the scar by

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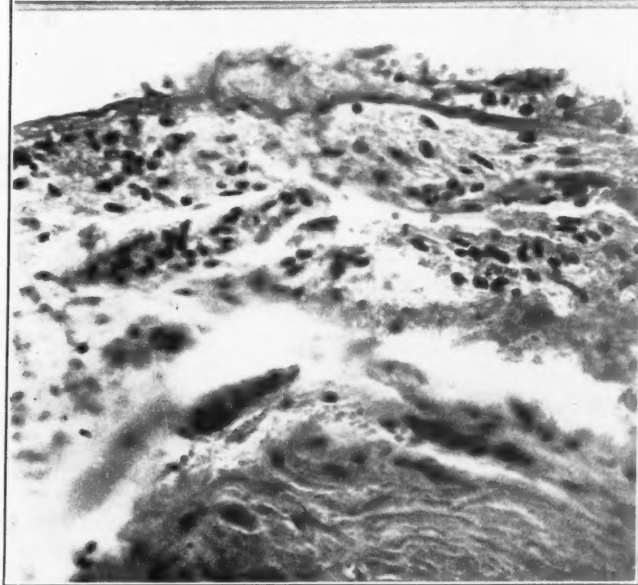


Fig. 1.—Human uterus, five days after cesarean section. Edges held together by a deposit of fibrin. No evidence of fibroblastic proliferation in this area.

Fig. 2.—Human uterus, five days after cesarean section. Marked proliferation of fibroblasts along the line of incision in the upper portion of the picture. Below is the smooth muscle of the uterine wall.

distending the uterine muscle, including the scar, with weights attached. As the weights were increased the strip ruptured and rupture always took place outside the line of incision. These experiments, seven in number, were carried out from seven to ten weeks after the operation.

Losee, in 1917, mentions the description of Couvelaire, and also describes his impression of early healing. He states that in the clear wound, after incision, leuco-

cytes, red blood cells, fibrin and later, young connective tissue cells separate the surfaces. These afterward are obliterated and eventually the muscle and fibrous tissue strands, separating the bundles, assume the relationship normally observed in other areas of the post-partum uterus. Other than a thickened peritoneum there is no scar tissue observed microscopically or macroscopically in the line of former incision when examined at subsequent cesarean section operation, provided healing has occurred under normal conditions. Losee's descriptions are chiefly those of the late scar at subsequent cesarean section. Although he mentions this description of early healing, apparently it is not based on studies of early wounds.

We are including several of the illustrations of our previous paper in this one, to make comparisons with our findings in the rabbit. The accompanying legends for these illustrations, we believe, are sufficient to describe the findings.

The material for this study was derived from the uteri of rabbits. Abdominal section was done on pregnant rabbits. The uteri of these rabbits were opened. Each fetus and its placenta were removed and the uterine wall closed by silk sutures. In most cases it was necessary to make two or more incisions to empty the uterus. Healing was allowed to progress for various periods of time, three, six, nine, twelve, eighteen, and twenty-six days. At the end of the desired number of days, the animals were sacrificed and sections were obtained at the site of the uterine scar.

While these observations were being made, three human uteri were obtained that contained scars of previous cesarean sections. In the human uteri the scars were all more than two years old and were obtained at the time of subsequent cesarean section and hysterectomy.

In each case the sections were stained with hematoxylin and eosin to show the usual tissue picture and with Orcein-Van Gieson stain to show differential histology. With Orcein-Van Gieson stain the muscle fibers stain yellow, the connective tissue red and red-brown, while the elastic tissue, as seen in the blood vessels, stains almost black. The fibroblasts stain almost a pure light red.

RABBIT 1971.—Uterine scar after three days. In the three-day scar a very marked and rapid reaction has taken place. In spite of the very recent incision of the wall, the repair process is well advanced. Due to the quite recent damage to the wall, the sections were quite fragile when cut. Repeated sections cut from celloidin and paraffin blocks show the main changes to be as follows:

The defect is clearly seen in all sections. Over the "V" shaped defect at the peritoneal surface is an accumulation of fibrin, old blood and leucocytic reaction. This tends to form also about the free ends of the suture material. Beneath this debris there is a new growth of fibroblasts growing from the connective tissue at the peritoneal surface. As the defect is followed it is seen that the tissue at the edge is composed of fibroblasts that run in the direction of the incision. The muscle layers have retracted in such a way that the outer longitudinal layer turns inward, while the inner circular layer of muscle fibers has entirely pulled away from the region of the defect.

The endometrial layer in general at the vicinity of the wound shows a tendency toward eversion. The endometrium shows fibroblastic activity in the stroma in the region of the wound. The stroma shows a fresh fibrillar appearance taking on increased pink stain in the Orcein-Van Gieson stained sections.

RABBIT 1972.—Uterine scar after six days. In the uterus with the scar at six days, there is great progress in healing. Where the edges have been well approximated, there is very good union between the two sides. The endometrium everts to a variable degree to close the defect on the inner surface. The inner circular layer of muscle shows a change in the direction of the fibers with many fibroblasts

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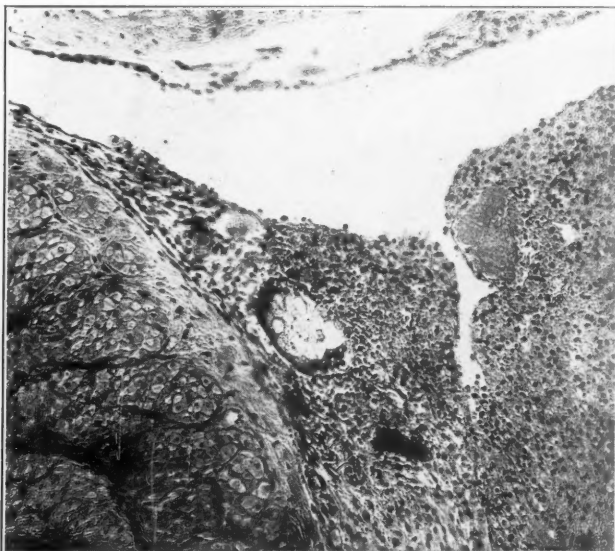


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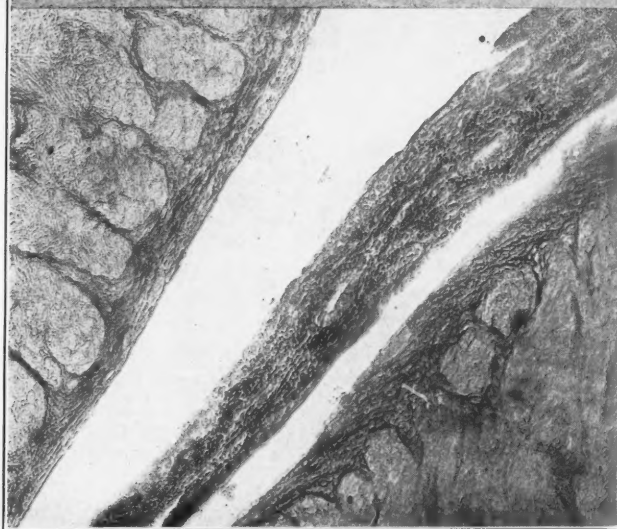


Fig. 3.—Rabbit uterus. Outer portion of three-day-old scar showing defect at peritoneal surface filled with fibrin and leucocytes. At the margins of the muscle there is the fibroblastic proliferation covering the muscle edges.

Fig. 4.—Rabbit uterus 1971. Three-day-old scar with Orcein-Van Gieson stain. Inner half of line of closure showing connective tissue proliferation covering each side of muscle edge and growing upward from endometrium.

between the ends of the muscle bundles. There is little change in the pattern of the outer longitudinal muscle layer. Beneath the peritoneal surface there is some connective tissue increase. In sections where the approximation was not so good, there

is much the same reaction in the tissues, but the edges have separated and the fibroblasts run in the direction of the line of incision and cover the muscle edges. The epithelium from the peritoneal surface and from the endometrial surface grows over the defective portion of the surface.

RABBIT 1964.—Uterine scar after nine days. In one of the scars there is the formation of a fistula with the endometrium everting for a distance and the peritoneal surface inverting, with epithelial lining to the entire tract. Over the "V"

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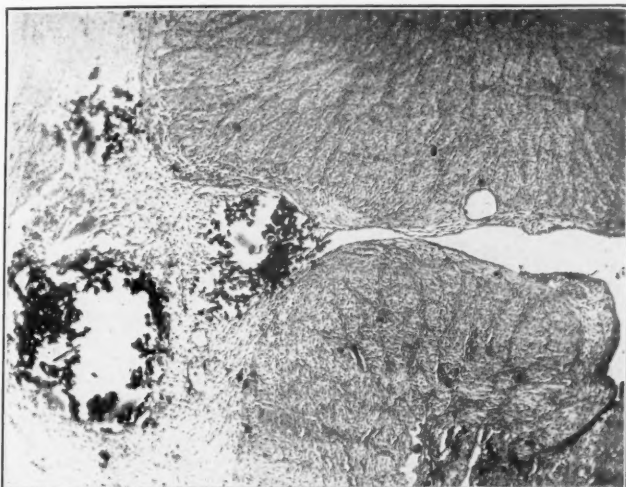


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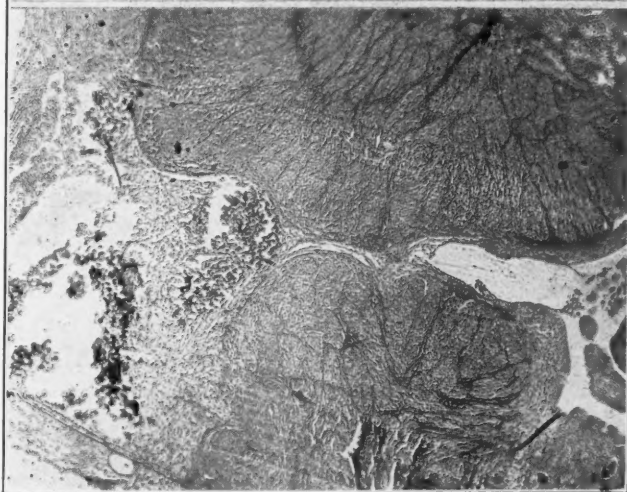


Fig. 5.—Rabbit uterus 1972. Section through entire thickness of uterine wall at six days. Healing has been retarded in this scar. Note connective tissue covering edges along entire thickness of wall.

Fig. 6.—Same as Fig. 5, with Orcein-Van Gieson stain.

shaped defect at the peritoneal surface there is a marked fibrin and leucocytic reaction. At the edges of the area is a fine fibroblastic proliferation. The appearance is that of a formation of a fistulous tract with a protective reaction over the defective portion.

The better healed scars at nine days show the following uniform changes. At the peritoneal surface is a fine fibroblastic reaction with thickening over the entire

area covering the defect. There is a separation of the two sides of the muscularis with the intervening portion entirely filled with a fairly dense connective tissue. In this, several new blood vessels and a few small endometrial glands are seen. The direction of the stroma of this tissue is parallel with the direction of the incision. At the ends of the muscle bundles on either side is an area composed of fine fibroblasts from the connective tissue of the muscle. At the inner ends of these fibers, they tend to direct their course toward the central connective tissue. At the endometrial layer there is some thickening and extension toward the muscularis.

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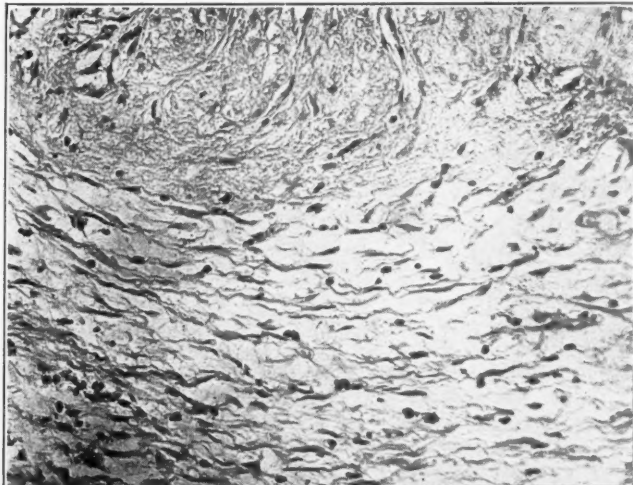


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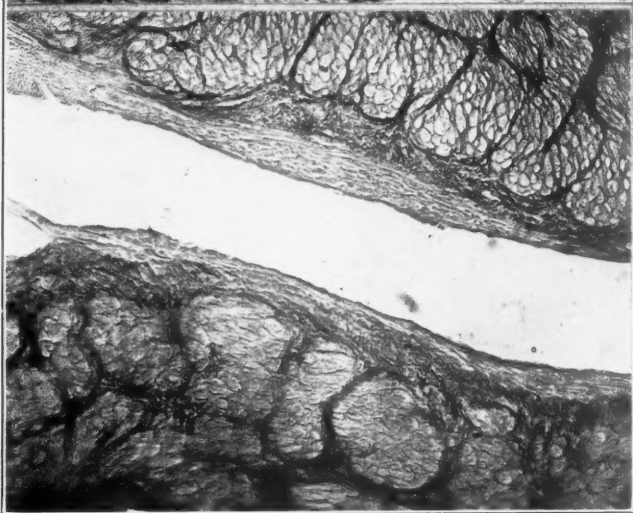


Fig. 7.—Rabbit uterus, twelve-day-old scar. High power through central healed portion stained with hematoxylin-eosin stain to show fibroblasts forming line of closure.

Fig. 8.—Rabbit uterus 1971. Three-day scar, showing arrangement of connective tissue along the ununited edges of the incision and about the muscle bundles. Orcein-Van Gieson stain.

RABBIT 1962.—Uterine scar after ten days in control rabbit. In the unsutured scar the union has been unusually good. The area of union is found only with difficulty. There is very little reaction on the peritoneal surface. In the endometrial layer there is some increased thickening toward the muscularis. There is slight re-

duction in the thickness of the circular layer toward the outside, due to the retraction of fibers in the inside portion of the circular layer. Very little increase in connective tissue appears in any of these sections. Good union occurred in each scar.

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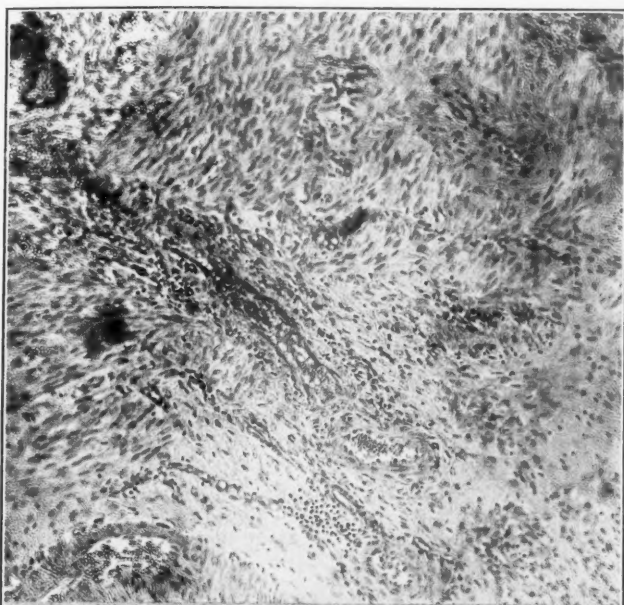


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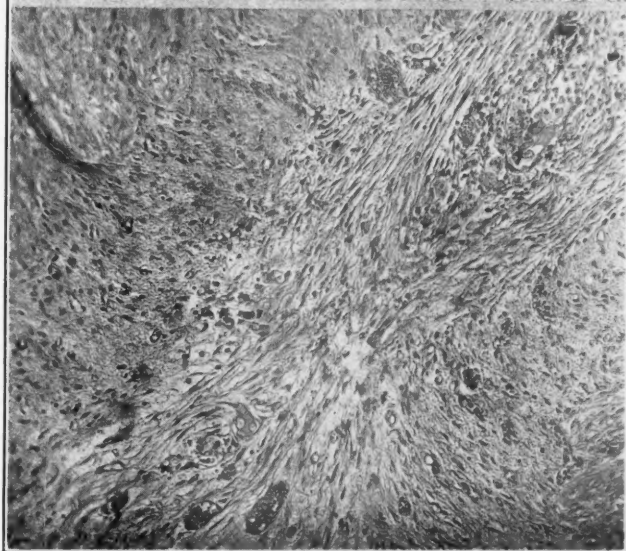


Fig. 9.—Rabbit uterus 1972. Section through portion of well healed scar at six days. Note defect in muscle pattern closed by connective tissue proliferation.

Fig. 10.—Rabbit uterus 1964. Nine-day scar showing closure of incision by connective tissue.

RABBIT 1955.—Uterine scar after twelve days. In all of the scars of this age there is more reaction about the peritoneal surface than in the older scars. This reaction is characterized by an increase in the subperitoneal connective tissue, arranged in a

loose network which dips in at the site of closure, and becomes thinner and more dense until it is lost in the connective tissue among the bundles of the longitudinal muscle layer. There is little change in the circular layer except for some reduction in the thickness due to eversion of the endometrial layer.

In one of the twelve-day-old scars, union between the two sides has failed to take place and a fistula has resulted in part of the length of the scar. This fistula is lined by epithelium from endometrium to peritoneum. There is no reduction in thickness of the uterine wall at this region. There is an increase in loose connective tissue beneath the epithelium and covering the muscle layer along the sides of the fistula. The circular muscle has been reduced at the site of the fistula. The longitudinal layer is not much altered.

RABBIT.—Uterine scar after twenty-six days. Under low magnification the transverse section of the uterus showed that the wall, at the site of the closure, was not appreciably different in thickness in any of the sections. With low magnification there was some paleness in the area of closure.

About the silk sutures there was considerable reaction with increase in connective tissue and some giant cell reaction. In these areas the pattern of the tissues seemed considerably disturbed. The tissue fibers about the sutures assumed a more concentric arrangement.

When the circular layer is seen, it is almost impossible to follow the course of union, due to the course of the connective tissue which is in general parallel to the direction of the muscle fibers. In the Orcein-Van Gieson stains no definite line of union could be seen in the circular layer.

CESAREAN SCAR 17991.—The sections of the uterine wall at the site of the scar show no evidence of thinning of the entire wall. The course of the scar is traced through the entire section with difficulty, due to the variation in the course of the line of union. On the peritoneal surface there is some irregularity and increase in connective tissue beneath the peritoneum. This moderate increase of loosely arranged connective tissue is seen dipping into the muscle of the outer third of the uterine wall at the site of union.

In the middle third of the uterine wall the continuity of the scar is lost, due to the ramification of the connective tissue (which is only slightly increased) between the muscle bundles.

In the inner third of the uterine wall the connective tissue again shows some increase along the line of closure. Here the course of the muscle fibers becomes a little more parallel to the line of union. In this more evident portion of connective tissue are areas of decidual cells which become increased in numbers as the decidual surface is approached. This eventually becomes part of the decidual layer itself. Decidual cells in considerable numbers are found in one section in the line of union as far out as the outer half of the uterine wall.

CESAREAN SCAR 17779.—In each of the blocks from the four levels of the uterus in which the scar was seen in the gross, portions of the scar may be seen microscopically. The scar is represented only by a line of union between the muscle bundles. There is no evident thinning of the uterine wall.

Starting at the peritoneal surface the site of the scar is evidenced by a slight depression at the surface. Here the peritoneal surface is irregular. By following the muscles across the section it is possible to follow the course of the line of union of the two sides of the old incision. This union is by no means a straight line, but it follows a very irregular course. The course runs down between the muscle bundles with numerous ramifications. It is traced by the irregularity in the pattern of the muscle bundles on either side of the site of incision. As these bundles approach the site of incision, they frequently change their course or become loosely interlaced across the area that was the original defect. Marking the original break in the uterine wall, which has now firmly united, is the slight increase in connective tissue present between and about the muscle fibers that at first marked the edge of the incision. This rather loosely arranged connective tissue forms a reticular structure about the muscle bundles at the site of the defect. In no place is there any wide area of connective tissue between the muscle bundle ends. This may be traced by following the pattern in the Orcein-Van Gieson stained sections.

As the decidual surface is approached, we find the loose connective tissue replaced by decidual tissue which has developed at the portion of the line of closure. These decidual transplants may be found in some of the sections to a much greater depth than in others.

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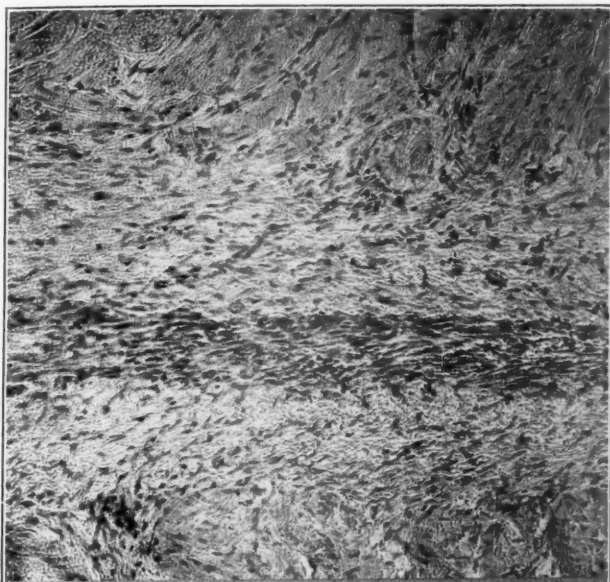


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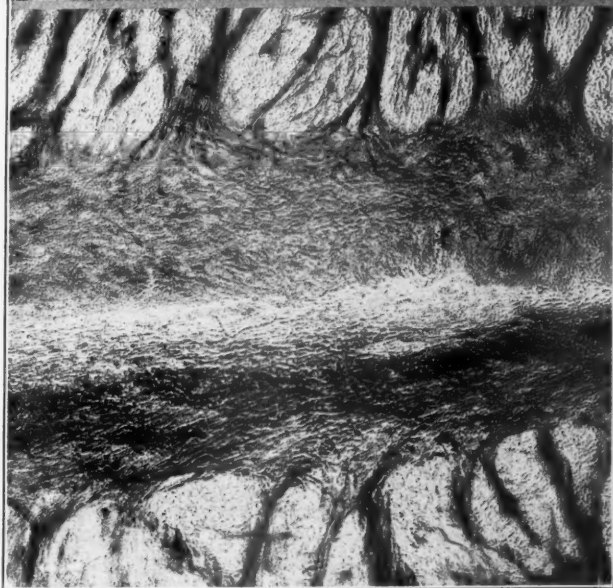


Fig. 11.—Dog uterus, five-day scar. Hematoxylin-eosin stain. Section showing the thick line of fibroblasts holding the edges of the incision together.

Fig. 12.—Dog uterus, five-day scar. Orcein-Van Gieson stain of Fig. 11. Heavy black structure indicates a large amount of fibrous tissue along the line of incision.

Where the decidual tissue extends deeply out into the muscle there is also marked invasion of the tissues by trophoblastic cells.

In addition to the study in the rabbit, one pregnant dog was used. The animal was sacrificed on the fifth day and the incision shows beautifully the extensive fibroblastic proliferation on each side.

CONCLUSIONS

From the study of the series of uteri from pregnant rabbits, we feel that the healing process is entirely similar to that in guinea pigs, that healing takes place chiefly by the proliferation of fibroblasts along the line of incision entering the spaces between the adjacent muscle bundles. As the scar shrinks, this becomes less perceptible, and it is difficult to demonstrate the line of incision with ordinary hemotoxylin-eosin stains after a two-weeks' period. Special stains, namely Van Gieson, bring out this differentiation.

In our previous paper, we clearly demonstrated the process of early healing, similar to that found by Losee. In uteri removed after previous cesarean section, the scar is frequently imperceptible, but in many instances increased connective tissue can be demonstrated. The reason that the scar is imperceptible is due to the marked shrinking of the newly developed connective tissue and the fact that it branches off in between the muscle bundles along the line of incision. Also, if the suturing has been well done, the muscle edges are in close apposition, which necessitates only a comparatively narrow line of healing. As this shrinking takes place, the normal relationship of smooth muscle and connective tissue, as occurs in the normal pattern of the noninjured uterus, is similar.

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DISCUSSION

DR. LYLE G. McNEILE, LOS ANGELES, CALIF. (By Invitation.)—Notwithstanding the fact that during the nearly twenty years which have elapsed since the authors first reported their conclusion that healing in the recently incised uterus occurs by scar tissue formation and not by muscle regeneration, no acceptable evidence to contradict their conclusions has been published. We still find the unqualified statement in textbooks published as late as 1937, that there is no scar tissue formation in such wounds. In these most recent textbooks the discussant had been unable to find any reference to the authors' earlier works on the subject.

The studies of Dr. Schwarz may be of great help in the problem of repeated cesarean section. On this subject we find violent differences of opinion. A large group of obstetricians maintain that the dictum "once a cesarean always a cesarean" should govern our procedure in every case which has been subjected to abdominal hysterotomy, regardless of the indication for the first cesarean section.

Another group considers this an exaggeration, explaining that "This . . . is in part based upon the belief that the uterine incision heals by the formation of scar tissue and that the newly formed connective tissue stretches when the uterus becomes

distended." This group firmly believes that healing is entirely by the process of muscle regeneration. It is obvious that if the authors' work is accepted, there must be some modification of this attitude.

A third group professes to be able to evaluate the integrity of the uterine scar by scrutinizing the history of the postoperative period following cesarean section. They claim that thinning of the uterine wall, or weak scar, is always associated with a febrile puerperium following the earlier operation. Except in the presence of marked disproportion, they do not consider the repetition necessary if the puerperium has been afebrile.

As a matter of fact, it has been repeatedly shown that an afebrile convalescence is not a criterion of the strength or weakness of a cesarean scar. Many of us have often observed, during an elective cesarean section performed before the onset of labor in patients whose previous convalescence has been entirely normal, the phenomenon of the so-called "window scar" formed by the complete separation of the old incision, with the infant clearly visible through the membranes.

No accurate statistics to show the incidence of rupture of the uterus through the scar of a cesarean section performed according to recent technique, are available at the present time. The old statistics show an incidence of about 4 per cent, but they are based upon a series of sections performed many years ago. I believe that at the Los Angeles County General Hospital the incidence is somewhat higher than this. In a statistical study of uterine ruptures occurring in my clinic, I found that our maternal mortality due to uterine rupture following previous cesarean section was 20 per cent. This compared very favorably with our mortality of 90 per cent due to ruptures in which a previous section was not a factor. The late Asa B. Davis, in a report covering ruptured uteri at the New York Lying-in Hospital, had similar results, and in explaining them he made one pertinent observation concerning the clinical effect of scar tissue formation in cesarean scars. He said, "The more favorable prognosis may be the result of the healed tissue in and about the previous cesarean scar, since this tissue does not bleed so freely as the tissue about a traumatic rupture." He evidently had reference to scar tissue formation.

DR. JOHN R. FRASER, MONTREAL, CANADA.—Ever since Säger first described the technique of cesarean section, the history of the operation has been a recital of a series of efforts to find the most suitable point of entrance into the uterus. We have two more or less accepted methods, either an incision through the fundus, a mesially placed incision, or a low segment incision. It is very difficult to contrast the incision in these two sites because anatomically they vary so greatly in structure. If one studies the uterus of a pregnant woman after the fifth month, visualizing the circulation by injection, one finds that the arterial supply of the fundus is tremendously increased and that the transverse vessels have now become very much larger. The fundus is completely encircled by these vessels, whereas in the lower segment there is practically an avascular zone. Now an incision through the fundus severs this ring of vessels. It is also difficult to provide the same environment for the healing of the fundal wound as in the lower segment, because of the restlessness of the fundus.

We believe, in addition, that the histology of the lower segment is different from the histology of the fundus, in that there is relatively little change in the lower segment as compared with the uterine body itself in pregnancy. There are thus many factors that will enter into the complete and perfect closure above when compared with the lower segment.

In surveying our cases at the Royal Victoria Hospital of 123 repeat sections, it was found that in eleven instances the wound in the uterus was decidedly unsatisfactory. It was interesting to inquire into the history of some of these patients. I discovered that practically none of these 11 patients had had a satisfactory convalescence free from tissue morbidity or general infection. Therefore, it seems that infection must play a considerable rôle in the prevention of a perfect closure in the fundus, whereas, in the lower segment the lessened tendency to hematoma

formation, and the decreased vascularity, with the fact of the incision being away from the site where the chorionic elements might enter into it, explains the more satisfactory healing.

Occasionally when resection of the tube is done for sterilization purposes, a regeneration may occur with complete functional restoration. The situation is somewhat similar in the uterus. If one can get a satisfactory closure, it seems to me one should get similarly a complete restoration in the uterine body, which after all is nothing but a tube. It would therefore seem that there must be other extraneous factors to explain the weak closure when it occurs.

Finally, in one part of the sections shown, a fibrous tissue skeleton was drawn across the wound. May I ask Dr. Schwarz whether he thinks that later perhaps the muscle would grow over and lead to a more natural appearance?

DR. FRED L. ADAIR, CHICAGO, ILL.—I am showing a section from the uterus of a woman, forty-nine years of age, who was operated upon for multiple fibroids of the uterus. She had had a classical cesarean section in her one and only pregnancy in 1921, and her uterus was removed in October, 1937.

In this scar there is a definite predominance of the scar tissue, which is shown by the blue stain, over the muscular tissue. This should answer the question as to the predominance of the scar tissue in the uterine incision.

DR. SCHWARZ (closing).—Answering Dr. Fraser's question, whether muscle regeneration could play any considerable part in later making the cesarean scar imperceptible, I would say that if muscle regeneration took place to any considerable degree in these scars it would be an additional factor, but I do not believe it would bring about any immediate healing. I believe the scar shrinks to such a degree that it simulates the normal pattern. Muscle regeneration is so slight and so small in amount that, in my opinion, it cannot play any considerable part in the healing of any incision.

PROBLEMS IN THE ETIOLOGY AND PREVENTION OF STILLBIRTHS*

THADDEUS L. MONTGOMERY, M.D., PHILADELPHIA, PA.

MY REMARKS are based upon preliminary observations in a study of intrauterine fetal death which is being conducted by the Obstetrical Society of Philadelphia. The appointment of a special committee for this purpose was made in the spring of 1937, the plans and organization for study were completed during the summer, and the collection of data begun in the fall. The assignment is for a year's investigation. While that period is incomplete, my intention here is to present an outline of the organization and a résumé of such problems in causation, classification, and prevention as may be of interest to a national organization which has for one of its purposes improvement of obstetric practice.

The subject of fetal mortality has not, in this country at least, received the same degree of attention as have considerations of maternal death. This is perhaps a natural tendency, for the exigency of maternal death was, and still is, great. A number of reports of fetal mortality have emanated from individual institutions^{1, 2, 6, 8, 9, 16-18} but only recently have studies of city, state, and national scope been undertaken. The investigation by the Children's Bureau of the Department of Labor^{4, 11, 15} of a cross section of hospitals of the United States has awakened new interest in the stillbirth problem. The analysis conducted by Bundesen, Fishbein, Dahms, and Potter in Chicago³ has proved stimulating. Valuable data were contributed by Plass and Alvis¹⁰ in a survey of problems in Iowa. Reports of interest have come from Wisconsin⁷ and Ohio.¹² Each community has approached the question in an individual way.

Philadelphia has attacked this problem in characteristic fashion. Being, as ever, short on funds but long on cooperation, the collection of data is being performed by unpaid voluntary representatives of each hospital, a plan of organization similar to that which was worked out for the Maternal Welfare Committee of Philadelphia by Dr. Philip F. Williams, whose pioneer work and suggestions have paved the way for this study. The selection of younger men from each hospital has been encouraged in order to spread the educational advantage of the study over as large a number as possible.

Once a month this larger committee of hospital representatives meets and analyzes a number of the reports which have been submitted during the previous four weeks. Inasmuch as it is impossible to bring all of the stillbirths before this larger group, cases are selected for consideration in which there is question of circumstance, of diagnosis, of cause of

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death, of treatment, or of classification. Each representative reports verbally the case from his own institution and gives such additional data as are requested in discussion. Ten or twelve such stillbirths are considered each month, the remainder being analyzed by the smaller original committee. Naturally at the monthly meetings the discussion leads off into numerous channels; many questions of policy and of recommendation come up for consideration. For all of us the vision of responsibility and of field of duty is enlarging as the investigation progresses.

For purposes of uniformity and of comparison, the standards of the Children's Bureau and the Subcommittee on Stillbirths of the American Public Health Association have been adopted. Although the law in Pennsylvania calls for the reporting of births as early as fourteen weeks,

THE OBSTETRICAL SOCIETY OF PHILADELPHIA

STUDY OF STILLBIRTHS
(STILLBIRTHS OF 20 OR MORE WEEKS' GESTATION)

1. Place of Birth _____ Delivery at _____ M. _____ 19____
(Name of hospital or other address if home delivery) (City) (State) (Year)

2. Mother: Name _____ Marital Status _____ Age _____ Race _____ Private Charity _____
(Maid, widow, etc.) (Color and Race) (Club)

Previous Medical History: _____

History of Endocrinopathy: _____

3. Children of this Mother: _____
(At the time of this birth and including this birth)

RESUME OF PREVIOUS PREGNANCIES						
NO.	YEAR	ABORTION/ PREMATURE FULL TERM	METHOD OF DELIVERY	DATE OF CHILD	IF DEAD CAUSE	REMARKS
1						
2						
3						
4						
5						
6						
7						
8						
9						

(Stillborn are separate sheet if necessary)

4. Present Pregnancy: _____
Was pregnancy normal? _____

Specify complications: _____ Nature of Prenatal Care _____
(Oblique, multiple, etc.)

Was serologic test for syphilis taken? _____ Date Result _____ Treatment for syphilis _____

5. Labor: Duration {1st stage _____ 2nd stage _____ Complications: _____

Was labor induced? _____ Indications: _____ Method: _____
(Include: drugs, lig., forceps, breech, etc.)

OVER

Fig. 1.—Card for reporting of stillbirths, front view.

we are including in this study only those in which the pregnancy is of twenty weeks or more duration. We follow the definition of stillbirth suggested in the Rules of Statistical Practice of the Public Health Association:

"A stillborn child is one which shows no evidence of life after complete birth (no breathing, no action of heart, no movement of voluntary muscle). Birth is considered complete when the child is altogether (head, trunk, and limbs) outside the body of the mother, even if the cord is uncut and the placenta still attached."

The card used for the collection of data (Figs. 1 and 2) is similar to the one used by the Children's Bureau, in that it contains all the items of data which are included in the latter. To these, however, have been added a number of items which we felt would prove of interest and importance: previous medical history, history of endocrinopathy, more

detailed résumé of previous pregnancies, nature of prenatal care, autopsy findings, special examinations of placenta and cord, and puerperal progress of mother. In this we were apparently justified, for without adding much to the burden of the reporter we are accumulating data which will add considerably to our knowledge when a final analysis is made.

Cards sufficient in number for the reporting of a year's stillbirths were placed in the hands of each hospital representative, together with directions for filling and return stamped envelopes for the mailing of each month's reports. For the reporting of stillbirths which occur in the home, a report card, directions, and return stamped envelope are mailed to the physician who attended the case. Every effort has thus been made to eliminate mechanical difficulty in getting reports in.

6. Was there an operation for delivery?.....		Specify:..... <small>(Include: Low, mid and high breech; version and extraction; breech delivery; cesarean; craniotomy, etc.)</small>	
Indications for operation:.....			
7. Drugs and anesthetics given:.....		<small>(No first and second stages, exclude third)</small>	
8. When did fetal death occur?		Was fetus macerated?.....	
Before labor.....	Before operation.....	When did Fetal Heart Sounds cease?.....	
During labor.....	During operation.....	Remarks:.....	
9. Fetus: Sex.....	Period of Gestation.....Weeks	Length.....Weight..... <small>(Crown to heel)</small>	If plural birth, Number in order of birth.....
10. Autopsy?.....Findings:.....			
11. Placenta and cord:..... <small>(Normal or abnormal. Specify lesions)</small>			
12. Puerperal condition of mother:..... <small>(Cause of mortality or morbidity if they have occurred)</small>			
13. Causes of the stillbirth (Indicate which is considered primary):			
(a) Found in the Fetus:.....			
(b) Found in the Secundines:.....			
(c) Diseases and conditions in mother during pregnancy and labor:.....			
14. Remarks:.....			
Record prepared by.....Date.....			

Fig. 2.—Card for reporting of stillbirths, back view.

The Department of Public Health under Dr. William C. Hunsicker has manifested enthusiastic interest and has given admirable cooperation. Copies of stillbirth report, birth certificate, and death certificate are forwarded to us as soon as the original is received at City Hall. Notification is then mailed to the hospital representative, informing him of each of the stillbirths in his institution. Without this information and assistance the committee would be at a loss to carry on.

PROGRESS OF THE ANALYSIS

From Oct. 1, 1937, to April 30, 1938, 449 certificates of stillbirths were forwarded to us by the Department of Vital Statistics. Of these, 361 occurred in the hospital and 88 in the home. At the time of last summation 290 of the hospital cases had been reported by the hospital representatives, and 45 of the stillbirths in the home

by attending physicians. Some forty or fifty of the remaining hospital reports as well as a number of the home reports would not normally be expected in until some time after this report was started. Of the hospital stillbirths more than 90 per cent are being reported by our hospital representatives and by the time the study is completed we hope to have them all. Of the home deliveries about 60 per cent are being reported by attending physicians.

We have not attempted to push the investigation of home cases beyond the mere request for information and the providing of cards for report. It has not seemed worth while or feasible to go further. For the sake of completeness it was decided originally to include the home deliveries in the study, fully realizing that the significance of the data thus obtained might be limited. Our expectations in this direction have proved correct, for only in the case of obvious etiologic factor has it been possible to ascribe a cause for fetal death. In most cases, lacking the assistance of autopsy report and clinical studies, the conclusion "Cause Unknown" has had to be set down.

As the study progresses we find the causes of death in the hospital cases falling into well-known groups:

Toxemia and nephritis in the mother	12.0%
Antenatal syphilis	9.0%
Complicated labor with birth injury	16.0%
Monstrosity and congenital deformity	7.0%
Placenta previa and premature separation of the placenta	12.5%
Prolapse of the cord	5.0%
Placental infarction	4.0%
Coroner's cases with no data available	3.5%
Miscellaneous conditions	16.0%
Cause unknown	19.0%

In many instances it has proved no simple task to fix a primary cause of death. In order to elicit as many factors as possible we provided space at the end of the card for the reporter's opinion as to the factors residing in the mother, the fetus, and the secundines, and recognizable factors in the father. The result is that a number and a variety of conditions have been reported, some of which were simply concomitant circumstances (such as cord around the neck); other important etiologic factors, e.g., toxemia in the mother, or infarction of the placenta; and many which were terminal pathologic lesions in the fetus, e.g., asphyxia, atelectasis, intracranial hemorrhage, exsanguination. Whether to set down the terminal lesion in the fetus as the primary cause of death, or the pathologic state of pregnancy or labor, was often a subject of debate.

Sellers¹³ in an excellent exposition of this problem, strongly favors the terminology suggested by the League of Nations Committee and the nomenclature employed by Holland. These terminologies emphasize the primacy of the pathologic factors in pregnancy and labor. Much may be said for them inasmuch as they lay the finger of accusation upon conditions which we hope by improved obstetric practice to prevent. Accordingly the primary cause of death in placenta previa would be set down as placenta previa and not as asphyxia (though the latter might be mentioned as a concomitant lesion), the cause of death in birth injury would be disproportion or malpresentation, or contracted pelvis and not intracranial hemorrhage (although it too might be mentioned as a terminal factor).

The Children's Bureau is approaching this problem with an open mind. The principal object of its study is to derive a satisfactory nomenclature for the causes of stillbirth. In our Philadelphia analysis we have as yet adopted no very definite policy and shall probably have to go back over all of our cases and make recapitulation of the causes of death.

CONSIDERATIONS OF PREVENTION

The interest of the committee in Philadelphia is not alone in the causes of death and the classification of factors, but also in the problem of preventability. For this reason each case is approached with the thought in mind, How might this fetal death at another time be prevented? With such considerations uppermost we have found ourselves, as we look back over our cases, dealing with three groups of fetal death: first, those in which the cause of death is obscure and unrecognizable and the possibility of prevention therefore nil; second, those in which the cause of stillbirth is evident but in which the possibility of prevention is limited by the inadequacy of our present knowledge; and third, those in which the cause of stillbirth is known, the method of prevention is known, but for one or more reasons the available knowledge has not been applied. Of the latter group there are many and antenatal syphilis is a striking example.

ANTENATAL SYPHILIS

The time is ripe for constructive action to prevent the further occurrence of antenatal syphilis. The laity has been made familiar with the problem, the physician is conscious of the requirements of the situation, now all that is required to remove this disgraceful blot upon obstetric practice is united and cooperative action.

Because of these considerations a subcommittee upon antenatal syphilis has been appointed to make further study in Philadelphia of this single problem. They report that of 24 stillbirths from antenatal syphilis, 20 were possibly preventable, that of 49 cases of unknown cause of death, 15 had no maternal Wassermann, that the practice of obtaining serologic tests in private patients is not a universal one, that while serologic tests are taken upon charity patients in hospital service, frequently the registration is late and the diagnosis and inception of treatment are still later, that pregnant patients are loath to go to several different clinics for observation and treatment during the burdensome period of pregnancy, and therefore are prone to neglect their ante-partum treatment, that unless measures are found for the inauguration of effective treatment before the fifth month of pregnancy, there is no certainty of prevention of congenital syphilis in the newborn infant.

We are now seeking authorization for cooperative action with the pathologists and the syphilologists to amend these difficulties: To reduce the expense of Wassermann rate to semiprivate patients, to subtly propagandize the necessity for serologic tests in all pregnant women, to set standards for syphilitic treatment in pregnancy, and provide detailed plans for the organization of antisyphilitic clinics as an integral part of the obstetric department, or at least as a branch service of the general antisyphilitic department of the hospital.

Such endeavors are rapidly becoming of themselves a separate undertaking in the maternal and fetal welfare of our city. When they are successfully consummated, we will feel that the science of obstetrics has made one of its proper contributions to the field of preventive medicine.

BIRTH INJURY

The importance of birth injury as a preventable factor in fetal mortality is well recognized. In our statistics to date, 16 per cent of the stillbirths have been attributed to birth trauma; of these three-fourths were held to be preventable.

Diagnosis of injury was made upon clinical history, circumstances of delivery, and revelations of autopsy. Since autopsies were not performed in a number of the cases, it is evident that a good deal was left to the opinion of the reporter and the judgment of the committee.

From the standpoint of fetal safety alone all deaths from birth injury might be classed as preventable, inasmuch as for each labor some extreme form of delivery might have been chosen to insure the intactness of fetal structure. From the broader standpoint of practical obstetrics, such criteria are not, however, acceptable. The committee has taken the latter viewpoint in its consideration of birth injuries.

In several instances reported it was obvious that the obstetrician had weighed the ultimate safety of the mother against the precarious state of the fetus, the labor having reached an advanced stage, and decided that the fetus should bear the burden of risk. Such cases were classified as nonpreventable fetal deaths.

In contrast with these few exceptions, there were 32 deaths in which faulty judgment or faulty technic on the part of the physician placed responsibility for unfavorable outcome at his door. Such cases have to do with bad obstetrics, and bad obstetrics has to do with maternal values as well as fetal, particularly in the misapplication of intrapartum tactics of delivery. Bad as the situation appears it is certainly not as bad as it was a number of years ago. My grounds for this statement is the parallelism in decline of maternal and stillbirth rates in our city (Fig. 3). In Fig. 3 it is to be noted that as the puerperal death rate has improved, there has been a steady fall in the stillbirth rate. Other phases of obstetric practice have to do with this improvement, but the more judicious application of operations of delivery has played an important rôle.



Fig. 3.—Maternal and fetal mortality (Philadelphia, 1931 to 1937).

Two years ago, in response to the suggestion of the Maternal Welfare Committee of the County Medical Society, a policy of consultation in all cases of delayed or difficult labor was adopted by the hospitals of Philadelphia. The analysis of stillbirths is affording a splendid opportunity to watch how it is being carried out and what its benefits are to be. Ultimately such policy must redound to benefit of mother and baby.

TOXEMIA AND NEPHRITIS

Toxemia of pregnancy and chronic nephritis complicating pregnancy stand close to birth injury as a cause of fetal fatality. At present little can be said for the preventability of fetal death in these cases; in the vast majority of cases we found that the fetus had succumbed to the disease or had been sacrificed before viability, in the interests of the mother. A few instances were held to be preventable in which prenatal care had been neglected or refused by the patient, or where supervision had been mismanaged by the physician. Considering the obscure nature of the toxemias,

this phase of obstetric pathology presents a dark picture for the life of the fetus in utero. Our knowledge of the subject up to the present has permitted us to extend but little hope in moderate and severe cases.^{9, 17}

Recent favorable reports upon the effect of active preparations of vitamin E¹⁴ in pregnancy toxemia, and in vasculonephritic disease have extended some hope in an otherwise black situation.

ANTENATAL HEMORRHAGE

Antenatal hemorrhage, the result of placenta previa, and premature separation take a heavy toll. In the former, considerations of maternal welfare make it often necessary to sacrifice the nonviable pregnancy in order to arrest hemorrhage. In the latter, the frequent association with nephritis and toxemia makes separation an ever present hazard, and the nonpreventable nature of the toxemia defies the best efforts of the obstetrician to salvage fetal life.

Even so, our figures for fetal mortality are better than those of years ago, for prompt diagnosis and prompt interference, by abdominal hysterotomy when feasible, have saved many babies.

Shute maintains that the early symptoms of premature separation, or at least of hemorrhagic infarction, can be recognized clinically, and that if heavy doses of wheat germ oil are instituted, further extension of the process can often be arrested. On this question we are open to conviction; our own observation has been that abruption of the placenta can be more certainly prevented if wheat germ oil therapy is instituted early in pregnancy in all patients who present a history of previous placental disturbance.

Prompt diagnosis and prompt institution of surgery insure, in most cases of placenta previa, a living child if the latter has reached the period of viability. The value of the x-ray in aiding with this diagnosis is not fully appreciated. The opaque medium technic by which the space intervening between bladder and presenting part has been held as a criterion of the presence of low implantation has not proved useful.

OTHER CAUSES OF FETAL DEATH

There are other causes of fetal death in which the outlook for improvement is discouraging: prolapse of the cord, knots, torsion, and constriction; necrosis of the placenta; congenital deformities and monstrosities of the fetus; peculiar disturbance associated with endocrinopathy in the parent. In this connection a number of cases have come up before the committee for discussion, in which possible hypothyroidism and extreme obesity have been associated with fetal death. In none of these instances have the studies of metabolism and endocrine function been sufficiently extensive to point certainly to the etiologic factor in fetal fatality. In addition there are those cases in which clinical history, details of labor, and autopsy fail to shed any light upon the cause, either in full-term or premature fetuses.

For the solution of these latter difficulties, we must wait upon a further progression in our general scientific knowledge. In the meantime, we urge upon our hospital representatives the careful study of all available data, the gross and histologic study of placenta, membranes, and cord, and in the institutions where facilities permit, such studies of endocrine function and hormone titre as may throw light upon these numerous questions. In those cases, particularly, in which there is a history of previous stillbirth, meticulous studies must be conducted during the course of pregnancy.

PROSPECTS FOR IMPROVEMENT IN STILLBIRTH RATES

Notwithstanding these difficult problems in management and occult factors in etiology, I can visualize a steady reduction in stillbirth rates in the next decade. Those qualities of insight, judgment, and technical ability which make for low mortality in skillful private practice are be-

coming more common acquisitions of the attendant at labor. Methods of prevention and treatment which are now in more or less experimental stage will merit wide acceptance and practical application. Further studies in the embryology and biologic processes of the developing ovum, and better understanding of the balance of hormonal secretions will pave the way for a solution of problems which now seem hopelessly obscure.

In the meantime, more and more attention is being paid to the cooperative study of fetal and maternal mortality. Physicians are analyzing the bad results in obstetric practice and pointing out for themselves the paths which lead to improvement. Such procedures can only have a salutary effect.

Those of us who participate in the Philadelphia study are encouraged to feel that the purposes for which it was undertaken are being accomplished, that data of interest and of value are being accumulated, that attention is being directed to an important problem; and we are trustful that as a result of this cooperative enterprise obstetric practice will be further improved.

Acknowledgment is made to the hospital representatives, to the clerical force, and to the other members of the original committee, Dr. Arthur First and Dr. John F. Sharkey.

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1930 CHESTNUT STREET

DISCUSSION

DR. FRED L. ADAIR, CHICAGO, ILL.—There are three major problems so far as mortality is concerned which have confronted the obstetrician. One, of course, is maternal mortality, another is fetal mortality, and a third is neonatal mortality. These problems have challenged the obstetricians because the rates in the past have remained unchanged for many years. A further problem arises due to the fact that studies of these mortalities indicate that many of the deaths are preventable.

Just what constitutes a stillbirth is a little difficult to define statistically. According to the rules of reportability in this country, at least in many states, any fetus which shows any sign of life whatsoever has to be considered a live birth. This rule applies in most of the registration areas to births after the fifth month of gestation. If one figures the fifth month as the calendar month, it amounts to from twenty-one to twenty-two weeks, so that any infant that is born after the fifth month, if it does not show any signs of life, would be regarded as a stillbirth. The period of previability extends from this time until the twenty-sixth or twenty-eighth

week. These live births necessarily end fatally in almost every case. At the Lying-in Hospital we practically never save a baby that weighs less than 1,000 gm. That weight is about as near the margin of viability as we can calculate.

The reports of the stillbirth certificates and death certificates of neonatal infants as to the cause of death do not mean a thing unless derived from autopsies, and in many autopsies we were unable to find the cause of death.

TABLE I. CAUSES OF DEATH IN 526 NECROPSIES—245 NEONATAL DEATHS AND 281 STILLBIRTHS

	NEONATAL DEATHS				STILLBIRTHS					
	TOTAL	TERM	PREMATURE	PREVIABLE	TOTAL	TERM	PREMATURE	PREVIABLE	NO.	PER CENT
Malformations	60	43	17	0	35	19	16	0	98	18.1
Hemorrhage*	57	32	23	2	26	20	6	0	83	15.8
Anoxemia	30	9	20	1	67	35	31	1	97	18.5
Infections	11	6	4	1	5	4	1	0	11	2.9
Miscellaneous	9	2	7	0	0	0	0	0	9	1.7
Undetermined	78	11	40	27	148	50	68	30	226	43.0
Total	245	103	111	31	281	128	122	31	526	100.0

*Hemorrhage includes only gross visceral and intracranial lesions.

Of the neonatal deaths, of which there were 245 out of 526 necropsies, malformations played the major role, especially in the term infants. We cannot prevent those deaths. The next largest group in which the cause of death was found was hemorrhage. This group includes all of the visceral hemorrhages and intracranial lesions. In the next group there was anoxemia or evidence of it. Then came infections in which syphilis, though involving only a small group, is included. Then there was the miscellaneous group of cases, especially of the premature infants, in which no pathologic lesion could be found which would account for the death.

The same thing holds true for the 281 stillbirths. Malformations still play the major role; hemorrhages come next; anoxemia plays a greater role than in the neonatal deaths, but the infections play only a small role. There are a large number of term and premature viable and of previable infants in which no demonstrable pathologic lesion could be found to account for the death.

TABLE II. COMPLICATIONS OF PREGNANCY ASSOCIATED WITH NEONATAL DEATHS AND STILLBIRTHS, CHICAGO LYING-IN HOSPITAL, 1931-1938

	LIVE BIRTHS		STILLBIRTHS		TOTAL
	DEATH DUE TO COMPLICATIONS	DEATH NOT DUE TO COMPLICATIONS	DEATH DUE TO COMPLICATIONS	DEATH NOT DUE TO COMPLICATIONS	
Abruptio placentae and placenta previa	25	14	73	5	117
Toxemia	28	16	61	9	114
Abruptio placentae and toxemia	9		19		28
Cord prolapse, etc.	6	4	33	11	54
Medical complications	14	3	8	3	28
Syphilis	2	4	2	5	13
Total	84	41	196	33	354

If these deaths are analyzed from the standpoint of maternal complications, placental causes associated with hemorrhage, such as placenta previa and premature placental separation, are found to be very important factors. Toxemias give even

a greater percentage than the hemorrhages. Toxemia is associated with ablatio placentae in a small group. Cord complications account for about 2 per cent, medical disorders in the mother for about 4 per cent, and syphilis for 1 per cent or less in the neonatal group.

In the stillbirth group these hemorrhagic conditions of the mother make up a very large group in which they were considered to be the cause of the stillbirth, and a relatively small group where some other conditions seemed to be the cause. The toxemia with ablatio placentae, cord prolapse, medical complications and syphilis played small parts also. Syphilis with us does not play as great a role as in some other sections, perhaps due partly to the fact that we do not deal with so many colored patients in whom the incidence of syphilis is universally higher than among the whites.

Studies of this kind, with autopsies showing as accurately as possible the causes of death, will help us in evaluating the proper obstetric procedure to prevent some of the deaths of the fetus and the newborn infant.

DR. GEORGE W. KOSMAK, NEW YORK, N. Y.—Mortality statistics from gross death rates have proved unsatisfactory. It was not until detailed studies based on individual case records were developed in the New York Academy of Medicine and the Philadelphia County Medical Society, that adequate estimates became available of the preventability factors in pregnancy fatalities. This same type of investigation must be applied to our stillbirths and neonatal deaths if we are to obtain any definite knowledge of how to prevent them, and it is of interest therefore to note the work of Dr. Montgomery and his Committee in Philadelphia.

The importance of reducing fetal deaths should be of paramount importance in aiding to maintain population balance in this country which is being affected both by voluntary and involuntary birth restriction. Although there is still a comparatively small excess of births over deaths, this does not furnish a conclusive and reliable indication of the capacity for future natural growth of our population, as pointed out by Dublin and others. This is because the birth rate and the death rate are both affected by the age distribution which is manifesting a shift to the older groups. If American reproductivity is admittedly on the decline, compensation must be sought and this can be accomplished by doing away with, as much as possible, the wastage of fetal life. Abortions in this country have been estimated by Taussig to number over 600,000 annually and the U. S. Census Bureau claims that 78,000 stillbirths occurred in 1936, not to mention neonatal deaths. If we finally conclude that at least half of these are preventable, some effect on maintaining our population balance should result.

Dr. Montgomery has classified stillbirths into groups, in each of which there is a definite factor of preventability: ante-partum syphilis can be effectively treated; pregnancy toxemia is being reduced; birth trauma does not afford a satisfactory picture, it should be much less; placental anomalies cannot be avoided but their handling can and has been improved. It would appear therefore that the principal attack should be made on syphilis, toxemia, and operative delivery. The latter in particular demands our more immediate attention. Have we not, in failing to observe proper indications, to insist on operative deliveries being carried out with competency and under proper environment, contributed to a stillbirth incidence which could be reduced? Dr. Elizabeth Tandy in her study of the subject finds that among one thousand cases of stillbirths distributed among 216 hospitals in which over 23,600 are delivered annually, 62 per cent were delivered spontaneously and 38 per cent by operative procedures. Forceps extractions preceded 35 per cent and were the most frequent, breech extractions were second with 25 per cent, versions accounted for 14 per cent and were third on the list and cesarean sections were fourth with 14 per cent. It was claimed that the fetus was dead before delivery in 73 per cent. One may question this figure but even if accepted as true, it leaves 27 per cent of the fetuses alive before operation was started. One cannot draw final conclusions from 1,000 cases but probably we can multiply these results by 78, for it is estimated that

78,000 stillbirths occur annually in the United States. There probably is little doubt that radical or incompetent obstetrics must be regarded as a definite factor and points the way to the solution of certain phases of the stillbirth problem.

It is to be hoped that the local situation so ably discussed by Dr. Montgomery may lead to similar case finding studies elsewhere. Continuing surveys, critical and informatory, are being initiated in New York City, and other communities should be stimulated to do the same. The New York Department of Health has developed a new form of certificate for all premature interruptions of pregnancy, the more detailed recording of which should in time give us further valuable information. The work of Dr. Montgomery and his Committee in Philadelphia, as well as the other activities referred to, should accomplish much in reducing the wastage of fetal life in this country. Dr. Montgomery's hopeful view that we may look forward to a reduction in fetal deaths is, in my opinion, dependent in large degree upon what the profession will do in exercising its own influence on those preventable factors which we have acknowledged as among the chief causes of stillbirths and neonatal deaths, including syphilis, toxemia, obstetric analgesia, and operative deliveries.

DR. PHILIP F. WILLIAMS, PHILADELPHIA, PA.—We have felt in Philadelphia that we should have studies made on all three types of mortality, not only maternal but also fetal and neonatal. In order to complete the studies the Department of Health has recently organized a Committee which at the present time is using the same cooperative form of study of neonatal deaths.

We have tried to organize in Philadelphia an obstetric staff conference in each hospital. The deaths are referred to these meetings for an opinion, then they go to the respective study committees. In that way each death is referred back to the smallest and nearest component group of physicians who have come in contact with that case. In that way a more detailed and close inspection of the circumstances surrounding the death is brought to light. If we are to effect any further reduction in the death rate it will be done by a more intimate study by the hospital conferences.

TECHNIC AND RESULTS OF ROUTINE FETAL ELECTROCARDIOGRAPHY DURING PREGNANCY*

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FETAL electrocardiography is a new method for determining during pregnancy whether or not the fetus is alive. It is the only graphic method yet available for such a purpose; apart from this method we still depend upon the stethoscope and on observations of fetal movements for such information.

In 1933, Steffan and Strassmann published the first fetal electrocardiograms taken on pregnant women, which, in three different external leads, gave definite evidence of action of the fetal heart superimposed on that of the mother.

In 1936, Strassmann gave the first report in this country regarding fetal electrocardiography during pregnancy. At that time, the technic was still in the stage of inception. Positive results had been obtained in only a third of the cases in which these observations were undertaken.

Having been able to identify definitely the fetal heart waves in the electrocardiogram of a pregnant woman, it has been only a matter of improving the technic to increase the percentage of positive results, in order to develop the method for routine purposes. It is one problem to create a new method of diagnosis and another to make such a method practical for routine use. To the latter end, it seemed advisable to keep the following principles in mind:

1. Any modification of the electrocardiographic apparatus which is generally in use was avoided. Changes were necessary, however, in the experimental stage, to obtain positive results. But, for routine purposes, such changes would make the practical use of fetal electrocardiography almost impossible.

2. Unusual leads, such as placing electrodes in the rectum or vagina or on the abdomen were not employed. Such technic would arouse antagonism and objections on the part of physicians and patients. Application of electrodes to extremities is familiar to everybody and, therefore, is preferable in fetal electrocardiography.

3. In spite of these limitations, it was necessary to increase the sensitivity of the test, in other words to increase the amplitude of the various waves. At the same time, it was necessary to decrease the shakiness and fuzziness of our tracings, that is, to cut out, as far as possible, muscular fibrillation and interference from the outside, especially that due to electric current.

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The final simple technic was developed on the basis of these three requirements. As is always the case, all kinds of complicated procedures were used before a simple technic was devised.

TECHNIC OF FETAL ELECTROCARDIOGRAPHY

As was expected previously, the routine Leads I, II, and III are fully satisfactory. However, in addition, we take Leads II and III on the right side after moving the electrode from the left thigh to the right thigh. Thus, we obtain a total of five tracings: (1) right arm—left arm; (2) right arm—left thigh; (3) left arm—left thigh; (4) right arm—right thigh; (5) left arm—right thigh.

These five leads cover the main directions the axis of the fetal heart might have in the body of the mother, projected on a two dimensional field. From our practical experience these usually are sufficient. In a three dimensional field, however, the possibilities concerning the direction of the axis of the fetal heart are unlimited. Some of our failures to record fetal components might be owing to this fact.

The electrodes we apply are those used routinely in the electrocardiographic laboratory of the Mayo Clinic. Their size is 6 inches (15.24 cm.) square. But, in contrast with the usual technic, the electrodes are fixed on the upper arm and thigh by bandages 4 inches in width. Previous to application, the bandages are soaked in saturated solution of sodium chloride; also, the skin and electrodes are moistened with the same solution. The reason for using saline solution and for applying the electrodes on the upper part of the extremities is, of course, to lose as little as possible of the fetal cardiac impulses. The nearer the electrodes are situated to the trunk of the body, the less resistance to be overcome.

Instead of saline solution, paste was tried in several cases, but without any advantage. In our particular type of work, use of paste between the skin and electrodes seemed to increase the fuzziness of the tracings, which made identification of the fetal waves more difficult. There does not seem to be much difference between use of saline solution and tap water.

Another difference between usual electrocardiographic technic and this technic concerns the position of the pregnant woman. We do not take the electrocardiogram with the patient in a sitting position. The patient is placed on a couch lying on her back, the head supported by a pillow. She must be absolutely comfortable and relaxed. After applying the electrodes, ten to fifteen minutes are allowed to elapse before starting the test. During this interval, the patient closes her eyes and rests. It is advisable to record 2 feet of film for each tracing. After Leads I, II, and III are taken, the electrode from the left thigh is changed to the right thigh and Leads II and III are repeated.

It is necessary to explain the significance of these procedures. A sitting position always requires some muscular action; this is not true of the supine position. This muscular action does not interfere with routine electrocardiography but it does interfere with fetal electrocardiography. For this same reason, in order to eliminate muscular fibrillation, it is advisable to wait ten or fifteen minutes after application of electrodes before taking the test. There will, of course, be some nervous patients who, in spite of these precautions, will have some muscular fibrillation which causes definite fuzziness of the tracing and makes identification of the fetal waves somewhat difficult.

Another point should be mentioned. Occurrence of disturbances from the outside, especially by other electric apparatus, must be prevented. The shakiness caused by extraneous electric current is easily noticeable on tracings. There may be small waves, regular in size and periodicity, which may not be annoying in routine electrocardiography, but may interfere with identification of fetal waves.

Thus, the main points in our technic of fetal electrocardiography, in short, are: (1) The patient is placed flat on her back on a couch. (2) The skin and the electrodes are moistened with saturated saline solution. (3) The electrodes are placed on the upper arms and left

thigh. (4) The electrodes then are fastened with bandages 4 inches wide which have been soaked in saturated saline solution. (5) The patient rests ten to fifteen minutes before the electrocardiogram is taken. (6) Tracings are taken with the usual leads (I, II, and III). (7) The electrode is changed from left thigh to right thigh. (8) Tracings then are repeated with Leads II and III (right arm—right thigh, left arm—right thigh, respectively). (9) Two feet of film should be taken for each tracing. (10) Outside disturbances from other electric apparatus should be guarded against.

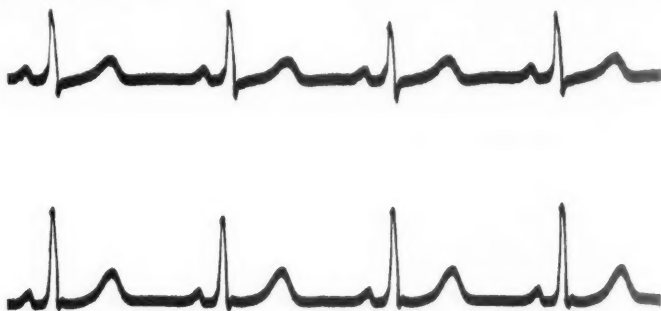


Fig. 1.—Lead I. Upper tracing taken with usual technic; patient in a sitting position. Lower tracing illustrates higher amplitude of waves and quieter zero line than in upper tracing; obtained by special technic, patient in supine position.



Fig. 2.—Lead II. Upper tracing taken with usual technic. Lower tracing taken with special technic. Fetal waves are indicated by arrows.

To illustrate the importance of the above-mentioned technical procedures, tracings are shown which were obtained on the same patient on the same day by taking the electrocardiograms by the usual technic and then by our special technic (Figs. 1, 2, 3, and 4).

The patient, aged 25 years, had experienced two previous pregnancies. The tracings shown were taken fifteen days before spontaneous delivery of her third child. The top tracings are those taken by the ordinary routine methods in the electrocardiographic laboratory; the bottom tracings were taken by application of our special technic.

Fig. 1 illustrates the first lead (right arm—left arm). As previously mentioned, the first lead usually does not give evidence of fetal action. When the fetus is in a vertical (vertex or breech) position, the axis of the heart is more or less vertical, the isoelectric zones are, therefore, horizontal and parallel to the first lead. However, it is obvious that, owing to our technic, the amplitude of the maternal R- and T-waves is larger than it is in tracings obtained by the usual routine methods and, at the same time, the zero line is quieter. Thus, the main conditions necessary to obtain the fetal waves in the other leads are fulfilled.

In Fig. 2, the upper tracing gives almost no evidence of fetal cardiac action. The lower tracing contains small negative deviations occurring at regular intervals (140 per minute) independent of the rhythm of the maternal waves. These negative waves, indicated by arrows, are the fetal R-waves.*

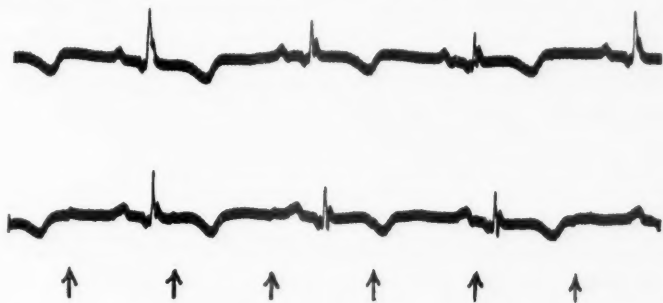


Fig. 3.—Lead III. Upper tracing, usual technic; no fetal waves. Lower tracing, special technic. Fetal waves are indicated by arrows.

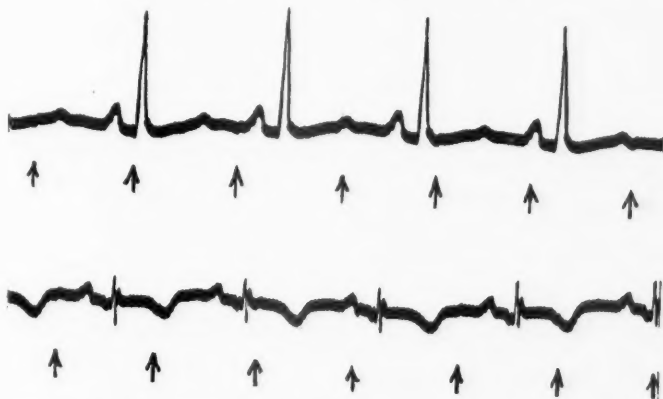


Fig. 4.—Right thigh leads with special technic. Fetal waves present in both tracings; indicated by arrows.

Lead III, illustrated in Fig. 3, usually gives the best results when the fetus is in a vertical position. In the lower tracing one recognizes distinctly the fetal waves, indicated by arrows. The upper tracing does not show the fetal waves at all. In addition, Fig. 4 contains the tracings obtained by Leads II and III taken from the right thigh using our technic. Both leads show the fetal waves distinctly. In all four positive leads, the fetal waves have the same rate, 140 per minute; this was verified by means of the stethoscope.

Fig. 5 illustrates the results obtained in the third lead of another pregnant woman eight days before delivery. The upper tracing taken in the usual manner

*Fetal waves in the original tracings are clearer than in photographs and reproductions.

contains shorter amplitudes and a restless zero line. The lower tracing illustrates the bigger maternal waves, a more restful zero line and in addition, the fetal waves in a most distinct way. There are no fetal waves visible in the upper tracing.

Twelve different patients were examined by electrocardiographic methods, first, in the usual manner and, then, by means of our technic as described above, one test after the other without making any changes in the apparatus. In all 12 cases fetal waves were recorded by means of our special technic. Only 3 of the 12 cases contained evidences of fetal waves when the usual technic was used, but these were less distinct.

Before giving our results there is one more important point, that is, how to read the fetal electrocardiograms, in other words, how to identify the fetal waves. Impulses of the fetal heart are too weak to give in a visible way, with our present technic, the same configuration of heart action that we find in the electrocardiogram of adults. The P- and T-waves do not show up. The R-waves usually are the only visible part of the fetal heart action in tracings taken during pregnancy. Since, in vertex presentation, the fetal heart is upside down in relation to the maternal heart, the fetal R-waves appear as negative waves (deflected

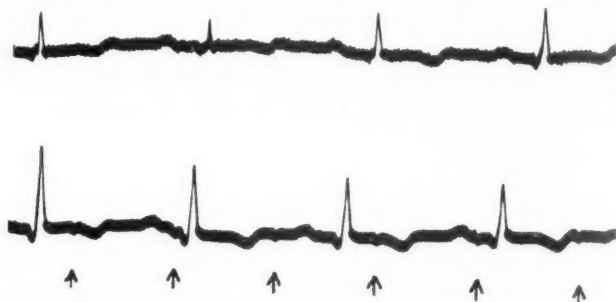


Fig. 5.—Lead III. Upper tracing taken with usual technic; short maternal R-waves and restless zero line. No fetal waves present. Lower tracing taken with special technic contains higher maternal R-waves than in upper tracing. Fetal waves indicated by arrows.

below the zero line), the amplitude of which varies between 1 and 2 mm. They are visible to the naked eye but, occasionally, use of a magnifying glass facilitates identification. In addition to the relatively large negative wave there is often present a short positive wave (deflected above the zero line). In breech presentations, the opposite occurred, that is a diphasic complex with a long positive and a short negative component. Such a positive R-wave is identified with more difficulty than the negative R-wave because, among the positive maternal waves, positive fetal waves do not show up quite as distinctly as do the negative waves that are associated with vertex presentation (see results). The fetal waves occur regularly in a rhythm independent of that of the mother. They are best visible when they appear between the maternal R- and T-waves or between the maternal T- and the following P-wave. When they coincide with the maternal QRS complex or with the T-wave they are hardly visible. The fetal waves have always the same size and form in one tracing and usually the same frequency of occurrence.

A single deviation or several similar deviations spread over the tracing may mean nothing. They may not be true fetal waves especially in fuzzy tracings. *A fetal electrocardiogram must be regarded as positive only if the waves can be followed through the entire tracing and the exact fetal heart rate can be determined.* It is necessary to use a ruler and a divider. With the divider, the distance between two waves that are suspected of being of fetal origin is measured and, using this same measurement an attempt is made to find the same type of wave always at the expected interval. If the fetal wave has been chosen properly, to begin with, such waves will be found present throughout the tracing, disappearing only when maternal waves are superimposed. It is advisable to indicate the fetal waves in ink on the electrocardiogram. After having marked at least ten to twenty consecutive fetal waves the ruler is used to figure the fetal heart rate. One inch of film represents one second; therefore, it is easy to find the fetal rate by counting the number of fetal waves in 3 to 6 inches of film and multiplying it by twenty or ten, respectively. Also, the maternal heart rate always should be determined. There is an interesting relationship between the maternal and the fetal heart rate. It is usually 3:5 or 4:7. The fetal rate is not quite twice as fast as that of the mother. The faster the pulse of the mother the faster is that of the fetus and vice versa. The smaller the fetus, the faster its pulse rate. Therefore, the earlier in pregnancy, the faster the fetal pulse. The relationship between the maternal and fetal heart rate opens a wide field for study, by use of the fetal electrocardiogram under various conditions, especially in labor.

RESULTS

We wish to emphasize again that a fetal electrocardiogram must be regarded as positive only if the fetal waves can be followed through the entire tracing and the exact fetal heart rate can be determined. This is the only way to avoid error. Many waves may be suspected of being of fetal origin but this should not be taken for granted without first having determined their definite rhythm and regular appearance. Our results are based on this principle.

Seventy electrocardiograms were recorded from 52 gravidas using the technic as described above. Sixty-one or 87 per cent were positive fetal electrocardiograms and 9 or 13 per cent were negative. Fifty-nine electrocardiograms were taken in 49 cases of vertex presentation. Fifty-four or 92 per cent of these were positive fetal electrocardiograms and 5 or 8 per cent were negative. Eleven electrocardiograms were taken in 3 cases of breech presentation. Seven or 64 per cent of these were positive fetal electrocardiograms and four or 36 per cent were negative.

The higher percentage of negative electrocardiograms in cases of breech presentation is owing to the fact, mentioned above, that the positive (deflected above the zero line) fetal deviations are recognized with more difficulty (owing to the confusing positive maternal waves) than are negative fetal waves (deflected below the zero line). On the other

hand, the diagnosis of breech presentation was made without examining the patient, on account of the positive form of the waves (deflected above the zero line).

The negative electrocardiograms in 5 cases of vertex presentation were mostly early cases. One electrocardiogram was taken forty-seven days before delivery, another thirty-eight days before delivery, and the third thirty-two days before delivery. In taking the fourth, sixteen days before delivery, paste was used instead of saline solution which, as mentioned above, caused more fuzziness in the tracings and made identification of fetal waves impossible. The fifth electrocardiogram, taken ten days before delivery, gave evidence of interference probably owing to muscular fibrillation. The patient was rather nervous.

The closer the patient is to the expected date of delivery, the higher is the percentage of positive fetal electrocardiograms. Table I gives the exact figures. In the last three weeks before the expected term, the highest percentage of positive fetal electrocardiograms occurred. This is especially clear when we consider the cases of vertex presentations only (Table II).

TABLE I. TIME BEFORE DELIVERY FETAL ELECTROCARDIOGRAM TAKEN

DAYS BEFORE DELIVERY	TOTAL ELECTRO-CARDIOGRAMS	RESULTS			
		POSITIVE		NEGATIVE	
		CASES	PER CENT	CASES	PER CENT
0-20	44	40	91	4	9
21-70	26	21	81	5	19
Total	70	61	87	9	13

TABLE II. TIME BEFORE DELIVERY FETAL ELECTROCARDIOGRAM TAKEN. VERTEX PRESENTATIONS

DAYS BEFORE DELIVERY	TOTAL ELECTRO-CARDIOGRAMS	RESULTS			
		POSITIVE		NEGATIVE	
		CASES	PER CENT	CASES	PER CENT
0-20	36	34	94	2	6
21-70	23	20	87	3	13
Total	59	54	92	5	8

Electrocardiograms were not taken before the last two months of pregnancy because we knew from previous experience that under such circumstances, with our present technic, too large a percentage of negative results is to be expected.

It is not proposed to use fetal electrocardiography as another test for pregnancy, but it is proposed that it be employed to determine and study fetal life during the last period of pregnancy, especially in the days preceding and during labor. If a physician should care to use fetal electrocardiography, he should first take tracings only in the last three weeks of pregnancy until he becomes familiar with the method and acquires the ability to read the tracings. The reason for this, as previously stated, is that the closer the patient is to the expected term, the more leads become

positive in the electrocardiogram. Table III illustrates in how many leads positive fetal electrocardiograms were obtained. Three-fourths of positive fetal electrocardiograms occurred in at least two leads and almost a third of them in four leads.

The relationship between the time before delivery and the number of positive leads is illustrated in Table IV. During the last three weeks before delivery more than twice as many fetal electrocardiograms are positive in four different leads (38 per cent) as occur during the time previous to three weeks before term (14 per cent). The reason for this lies in the fact that the larger the fetus the more its heart action shows up, not only in the favorable leads but also in the others.

TABLE III. POSITIVE FETAL ELECTROCARDIOGRAMS OBTAINED

POSITIVE IN	NUMBER	PER CENT
1 Lead	15	25
2 Leads	19	31
3 Leads	9	15
4 Leads	18	29
Total	61	100

TABLE IV. RELATIONSHIP OF NUMBER OF POSITIVE LEADS TO TIME BEFORE DELIVERY

POSITIVE IN	0-20 DAYS		21-70 DAYS	
	NUMBER	PER CENT	NUMBER	PER CENT
1 Lead	10	25	5	24
2 Leads	11	27	8	38
3 Leads	4	10	5	24
4 Leads	15	38	3	14
Total	40	100	21	100

As an example of a positive fetal electrocardiogram recorded at the end of a full-term pregnancy, tracings of a gravida, aged 20 years, were chosen. The electrocardiogram was taken on Dec. 8, 1937. The following day a female baby who weighed 3,510 gm. was delivered by forceps. The electrocardiogram gives evidence of fetal waves in four leads (Figs. 6 and 7). They are indicated by arrows. The maternal heart rate decreased during the test from 98 to 88; that of the fetus, consequently, decreased from 150 to 144. Not all the tracings, of course, are as clear as this one. Especially, not all leads are equally favorable in the earlier cases. Therefore, it is necessary to mention the value of the various leads that are employed.

In 61 positive fetal electrocardiograms, there were 152 positive tracings. The tracing of the first lead was never positive; the tracing of the second lead was positive in 29 instances; the third in 46; the fourth lead (right arm—right leg) in 32, and the fifth lead (left arm—right leg) in 45 instances. The reason why the tracing of the first lead was never positive has been mentioned above. In longitudinal positions (vertex or breech presentation) the axis of the fetal heart is vertical. Therefore, the iso-electric zones are horizontal and are parallel with the first lead (right arm—left arm). We did not have a case of transverse position of the fetus in our series. In this particular instance, however, the tracing of the first lead might be expected to be positive.

It is interesting that the number of positive tracings was highest and almost the same (46 and 45) in the third lead and in the fifth (left arm—right leg). The reason is that of all leads employed these leads are the most favorable for recording impulses from the fetus in left vertex position, and this position occurs more frequently than right vertex position. In the latter position, the second and the fourth leads (right arm—right leg) are the most favorable, corresponding to the axis of



Fig. 6.—Leads II and III taken one day before delivery. Fetal waves indicated by arrows.



Fig. 7.—Right thigh leads; same patient as in Fig. 6. Fetal waves indicated by arrows.

the fetal heart. Therefore, it is not amazing that the incidence of the number of fetal tracings obtained from these two leads is very much the same (29 and 32).

This very fact that two leads are linked together in their positive or negative results also explains the observation that a greater number of electrocardiograms is positive in two or in four leads (31 per cent and 29 per cent, respectively) than in three leads (15 per cent, Table III).

The first appearance of fetal waves usually occurs in that lead which is most parallel with the axis of the fetal heart (25 per cent of positive cases). There is another factor which may explain the higher incidence of fetal waves in Lead III in contrast with Lead II. Examination of the tracings will show that the tracing from the second lead usually has a more fuzzy character than that of the third lead, a factor which makes identification of the fetal waves more difficult in the second lead.

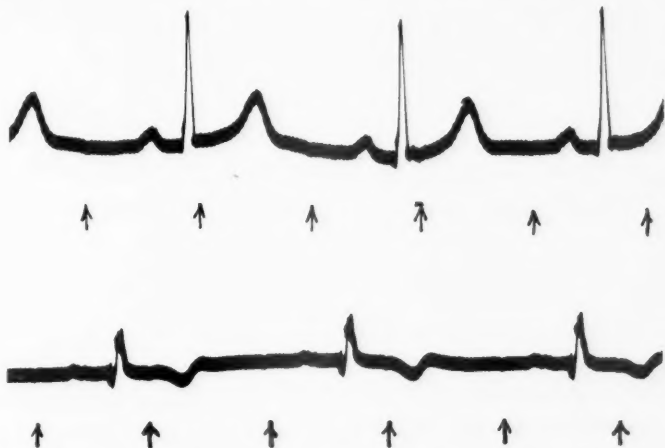


Fig. 8.—Fetal electrocardiogram taken forty-three days before term, thirty days before delivery. Fetal heart tones not heard through stethoscope. Fetal waves in Leads II and III indicated by arrows.

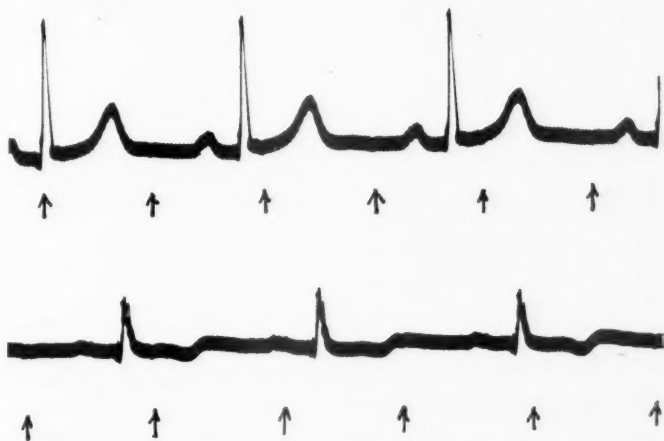


Fig. 9.—Right thigh leads; same patient as in Fig. 8. Fetal waves indicated by arrows.

Having reported the technic and results of fetal electrocardiography we should discuss the value of this test. There is a practical and a scientific side to every medical method. The practical value of the fetal electrocardiogram can be illustrated best by report of a case in our series.

The patient, aged 27 years, weight $179\frac{3}{4}$ pounds (81.6 kg.), had her last menstrual period on April 20, 1937. She was a para ii, having had two spontaneous

deliveries on May 31, 1935 and July 24, 1936. On Aug. 10, 1935, a large ovarian cyst, 20 by 15 cm. which weighed 1,050 gm. had been removed at the clinic. When she came to the clinic on Dec. 3, 1937, she had all signs of pregnancy but fetal heart tones could not be heard. It was fifty-five days before the expected date of delivery. The fetal electrocardiogram taken on the same day was positive in the third lead (fetal rate 138). Two weeks later, on Dec. 27, 1937 and finally on Jan. 4, 1938, fetal heart tones could not be heard. Electrocardiograms taken on Dec. 15, 1937, and Dec. 27, 1937 were both positive in four leads. A living male baby (3,850 gm.) was born spontaneously on Jan. 14, 1938. The tracings in Figs. 8 and 9 were taken on Dec. 15, 1937, forty-three days before the expected date and thirty days before delivery.

In case doubt exists as to whether the fetus is alive during the last two months of pregnancy, especially if such a doubt arises when the patient is in labor, fetal electrocardiography might be of practical value.

The scientific side of this test opens an even wider field. The only method available for study and observation of the condition of the fetus in pregnancy and labor, up to now, has been that of stethoscopic examination which, of course, for practical purposes will never be replaced. For research work, however, a more accurate test is needed. The fetal electrocardiogram recorded in pregnancy and labor gives us records of documental value, tracings which show the action of the maternal heart and that of the fetus at the same time. The relationship between the circulation of the mother and that of the unborn infant can be studied under various conditions. It is not necessary to repeat what was said about other uses of fetal electrocardiography in the paper given on Dec. 2, 1936.² Fetal electrocardiography is still a new method which can be improved. However, it has possibilities of being of value for practical and scientific purposes.

SUMMARY

The principles on which the routine technic of fetal electrocardiography has been developed are use of the electrocardiographic apparatus without modification, application of electrodes to the extremities only, increase of the amplitude of waves and decrease of the fuzziness of tracings by simple means. The technic of obtaining and interpreting fetal electrocardiograms is described in detail. The difference between the results obtained by use of the usual technic and those obtained by use of special technic is illustrated in Figs. 1 to 3.

Seventy fetal electrocardiograms were recorded from 52 patients during the last seventy days of pregnancy. Sixty-one or 87 per cent of the electrocardiograms were positive and 9 or 13 per cent were negative. During the last twenty days of pregnancy 40 out of 44 electrocardiograms or 91 per cent were positive. Between the twenty-first and seventieth day before delivery 21 out of 26 electrocardiograms or 81 per cent were positive. In cases of vertex presentation, during the last twenty days of pregnancy, 94 per cent of the electrocardiograms were positive and, between the twenty-first and seventieth days before delivery, 87 per cent were positive.

Besides the usual Leads I, II and III, two more leads were used (right arm—right thigh; left arm—right thigh). The largest number of positive results were obtained in the third lead (46) and in the fifth lead (left arm—right thigh) (45) because they are most favorable in the left vertex position of the fetus which is the most frequent position.

Twenty-five per cent of the positive fetal electrocardiograms were positive in only one lead, 31 per cent in two leads, 15 per cent in three leads and 29 per cent in four leads. In the last three weeks before delivery, 38 per cent of the tests were positive in four leads.

As an example of the practical value of the fetal electrocardiogram, a case is described and the electrocardiogram is shown in which the fetal heart tones could not be heard through the stethoscope and the electrocardiogram gave evidence of a living fetus fifty-five, forty-three, and thirty-one days before the expected term.

Fetal electrocardiography in pregnancy and labor gives objective graphic evidence regarding the viability of the fetus. This is of practical value in doubtful cases in which the older subjective methods, stethoscopic examination, and observation of fetal movements fail. By means of the technic presented, the rate, rhythm, and regularity of fetal heart action can be observed in the electrocardiogram. The scientific field of fetal electrocardiography might even be wider. Such a procedure renders possible observation of the fetus objectively under various conditions in pregnancy and labor. The relationship between maternal and fetal heart action can be easily studied.

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The author reports a case which definitely proves the longevity of spermatozoa. A sterile young woman anxious to bear children had an artificial insemination performed on the twenty-sixth day of the menstrual cycle, hence during a period of physiologic sterility. She menstruated normally two days later and following this abstained from coitus. She did not menstruate after this and subsequent examinations revealed a pregnancy the duration of which coincided with the menstrual history. Evidently in this case the spermatozoa had remained alive and capable of fertilization in the Fallopian tube until an ovum was liberated. Hence, it is possible for spermatozoa to retain their vitality for at least fifteen days. This fact speaks against the principles laid down by Ogino and Knaus concerning the physiologically sterile period.

J. P. GREENHILL.

THE RELATION OF BASAL BODY TEMPERATURE TO FERTILITY AND STERILITY IN WOMEN

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PERIODS of fertility and sterility undoubtedly occur during the menstrual cycle in the human female. These have been explained on theories for each of which some inadequacy must be admitted even with the most careful application of the principles embodied.

In this essay we present data which offer a practical method for the regulation of conception in fertile women. They may also be valuable in the study of women who are reputedly barren.

In the newer experimental approach to the subject of human ovulation many methods have been investigated. Most of these are in fair agreement. Some methods, however, are unsuitable for determining the day of rupture of the ovarian follicle and, in all, the difficulty of forecasting variability has been the chief handicap to practical application.

In the older literature pregnancy has been reported by different observers to result from exposure on nearly every day of the menstrual cycle. As late as 1927 Dickinson³ made an exhaustive survey of existing data and came to the conclusion that unexpected variability in ovulation constitutes a major hazard to estimation of temporary sterility by any set rule of thumb. At the very date of publication of Dickinson's conclusion there were in progress two investigations which have considerably clarified the dating of human ovulation.

Ogino,^{14, 15} following the method of L. Fraenkel,⁶ made an estimate of the ovulation date in the menstrual cycle by inspecting the ovaries in 83 laparotomies. He claimed a fertile period lasting from the nineteenth to the twelfth day before the oncoming menstrual period. This is not far from Fraenkel's observations published nineteen years previously (1911), although Ogino advocated a relationship of ovulation to the following, not to the preceding, menstruation.

Knaus¹² investigated the reactivity of the uterus to pituitrin and found that the human uterus contracts vigorously up to a date near the middle of the menstrual month when it suddenly becomes almost unresponsive. From existing experimental data he reasoned that corpus luteum inhibition produces the falling off in response and that since the corpus luteum requires about two days after rupture of the ovarian follicle to produce its effect, ovulation must have occurred two days before the negative response is observed. Knaus emphasized the correlation between ovulation thus determined and the oncoming menstruation, claiming ovulation on the fourteenth day preceding menstruation.

Hartman^{7, 8} studied the time of ovulation in the macaque by rectal palpation of the uterus and ovaries, confirming his observations by laparotomy. He further extended his investigation by securing pre-arranged conceptions and recovered embryos of known age from precise dating of fertilization. Subsequently he published a comprehensive critique of all the available data up to 1936. In this contribution⁹ he set down a review of his own data placing ovulation in the female macaque between the eighth and twenty-first days of the cycle. He is unwilling

to accept the narrowness of span of fertility as advocated by the Ogino-Knaus law, but is quite convinced that a safe period does exist especially during the last quarter of the menstrual cycle.

The data collected by Papanicolaou¹⁶ by the vaginal smear method indicate that in some women it is possible to determine ovulation within a span of two or three days. This information shows the highest number of ovulations to occur on days eleven, twelve, and thirteen with a range from days seven to seventeen. This method has both clinical and experimental application.

Studies by microscopic section of uterine mucous membrane as reported by Schroeder¹⁸ distinguish between nonsecretory (preovulatory) and secretory (post-ovulatory) phases of the mucous glands in the endometrium. Evaluation by this method is in keeping with the theory that ovulation occurs between the fourteenth and sixteenth days of the cycle. This method has been opposed by Evans and Swezy,⁵ the objection being that it is unreliable but Hartman⁹,¹⁰ defends it lending support from his observations on macaques.

Recently Burr, Hill and Allen¹ have applied the principle of electrical potential change to the study of follicle rupture and have been able to record showers of impulses of nervous origin at the time of ovulation in rabbits and more recently² also in women.

In the effort to obtain further information on human ovulation, I began, in 1930, to collect instances of carefully recorded coital exposure which resulted in pregnancy. By establishment of a special "cooperative" clinic at the Maternal Health Association of Cleveland, Ohio, I enlisted the assistance of young women planning pregnancy and willing to serve in an experiment in which the time of the midperiod could be determined.

For several years the women were instructed to keep menstrual records and note particularly signs of the midperiod (Mittelschmerz). On the basis of their cycles and midperiods thus defined, exposures were permitted often for a period of several months during what we believed to be the sterile days of the cycle, then a single exposure at the midperiod when we believed conception possible. The results from this experiment emphasized the need for more precise determination of the time of ovulation. Commencing in 1935 morning rectal temperatures were also taken by the women, and since then this has been a routine procedure.

In the early years of our experiment we accumulated information on the duration of the menstrual cycle in the women under observation and recorded their ability to distinguish midmenstrual signs which might be indicative of ovulation. We learned that the signs associated with ovulation are extremely varied and in many women are not recognizable. However, in some women there are definite sensations which, if recorded on the menstrual calendar, can be considered to date the ovulation. This is borne out by the fact that in 15 women, a single exposure at the time of subjective sensation has resulted in pregnancy. The sensations range from a slight temporary discomfort on one or other side of the lower abdomen to severe pain lasting for several hours. In some women there is a vaginal discharge at the midperiod, lasting from one to three days, and there may also be a small amount of bleeding. In one woman there was a regular one-day diarrhea at this time and in several others there were headache and sleeplessness. It seems evident

that symptoms may appear over a period of three days, these symptoms usually being more pronounced in those women who have had some inflammatory process in the uterus or oviducts. Rupture of the follicle may actually be felt by the woman after careful observation of her own temperature curve.

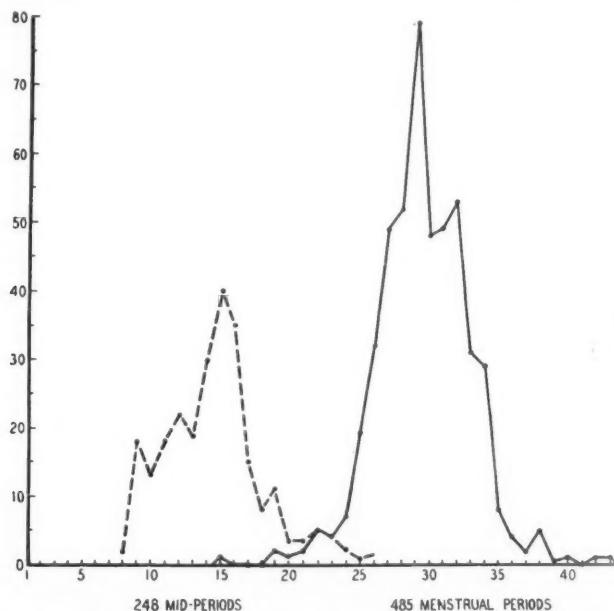


Fig. 1.—The incidence of the midperiod and duration of menstrual cycle. The majority of ovulations indicated by this determination of the midperiod falls between days nine and nineteen of the menstrual cycle with the highest incidence occurring on days fourteen, fifteen, and sixteen.

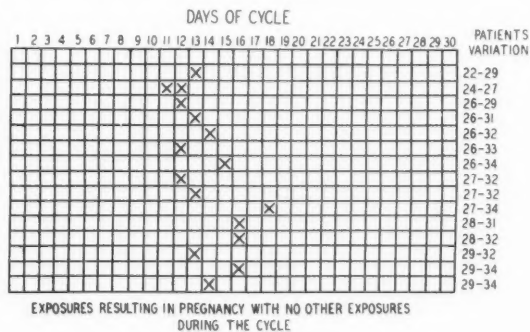


Fig. 2.—Sixteen planned pregnancies successfully started by using midperiod symptoms as indicative of ovarian follicle rupture.

A summary of the menstrual cycles and the observed midperiods is given in Fig. 1. It will be seen that the conformation of the curve of menstrual cycle is very similar in our group to that surveyed by Engle and Shelesnyak⁴ in 1934 and by others. The menstrual cycles in our women, whose ages range from twenty-five to thirty-six years, are very much more regular than those reported in younger women by Engle

and Shelesnyak. This is a fairly well-recognized stability that takes place within the older age group of which this evidence is an example. Our women are all married and living with their husbands. Many have had one or more children. There has been no selection on the basis of economic status. A midperiod indication is claimed by about 50 per cent of the women in our group and varies with the length of the cycle.

Fig. 2 shows the range in day of exposure in 16 planned pregnancies successfully started by using midperiod symptoms as indicative of ovarian follicle rupture. There were no exposures during the cycle other than those indicated and no subsequent exposures until after pregnancy had been proved. It will be noted that no pregnancy occurred before the eleventh day of the cycle nor after the eighteenth day regardless of cycle length. It is important to note that pregnancy never occurred at any other date of the menstrual cycle despite exposures permitted in previous months during the assumed sterile days.

Although the midperiod determination yielded interesting data, it is not a method of precision.

Our next step was the recording of early morning rectal temperature in the hope of more accurately dating ovulation, for Van de Velde¹⁹ in 1904 reported variations in body temperature during the menstrual cycle and in 1929 confirmed his observations by supplemental data.²⁰

Further information is essential because of occasional irregularities found in the cycles of all women. Harvey and Crockett¹¹ had already reported in 1932 the temperature record of one woman. Dr. Rubenstein, carrying on a parallel investigation in this laboratory, has recorded routine daily temperatures on a group of women and has recently published his findings.¹⁷

In arranging for single exposure pregnancies one must have ascertained the approximate ovulation date; even then, as is shown in our records of 81 women, pregnancy may not occur until after several timed exposures. The rhythmic rise and fall in the twenty-four-hour temperature record is an established fact, the lowest point being reached usually in the early morning. To standardize the procedure our women recorded their rectal temperature each morning before rising. This routine was carried out at approximately the same time every day. The temperatures were read and recorded to tenths of a degree. When these temperature records are plotted, the resulting curve usually shows that just before menstruation begins there is a slight fall in the temperature which, in most women, reaches 98° F. This level is maintained during the period of flow. At the end of the period there may be a temporary lowering of the temperature which then rises to somewhat above 98° before falling abruptly to reach its lowest level at the midperiod when it may descend to 97° or even lower. After this fall the temperature rises to a level usually above 98° F. and remains practically stationary until the onset of the next menstrual period. This phase is usually regarded as the lutein phase. It is true that not all menstrual cycles show these clear-cut variations, but in the 67 women studied this variation was characteristic of more than 80 per cent of the menstrual cycles.

Fig. 3 shows six successive menstrual cycles in one woman whose temperature curve presents a midperiod low level ascertained to coincide with ovulation through the occurrence of pregnancy from exposure at this precise date and this date only. In this woman, after pregnancy started, there was a fall of temperature at about the time of the expected ovulation of the succeeding cycle. Of 20 women whose pregnancies were planned from the temperature curve (Fig. 4), two, of whom this is one, showed a temperature drop at the first midperiod date after commencement of pregnancy. In the other 18, the temperature remained continuously between 98.5° and 99.5° F. after conception. From

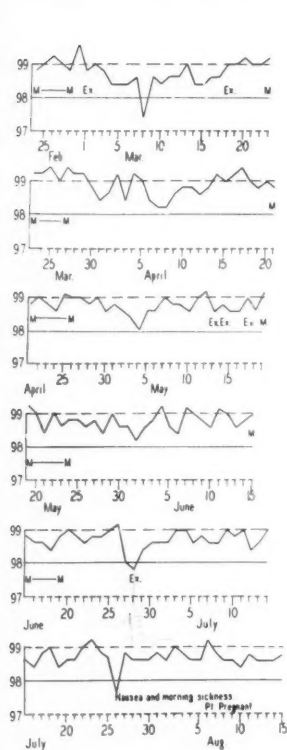


Fig. 3.

Fig. 3.—Six successive menstrual cycles in one woman whose temperature curve presents a midperiod low level ascertained to coincide with ovulation through the occurrence of pregnancy from exposure at this precise date and this date only.

Fig. 4.—The record of the last menstrual cycle in each of twenty women to illustrate the identification of ovulation with the approximate date of the midperiod low temperature. The date of exposure is marked by a cross and the duration of menstruation by a double-headed arrow.

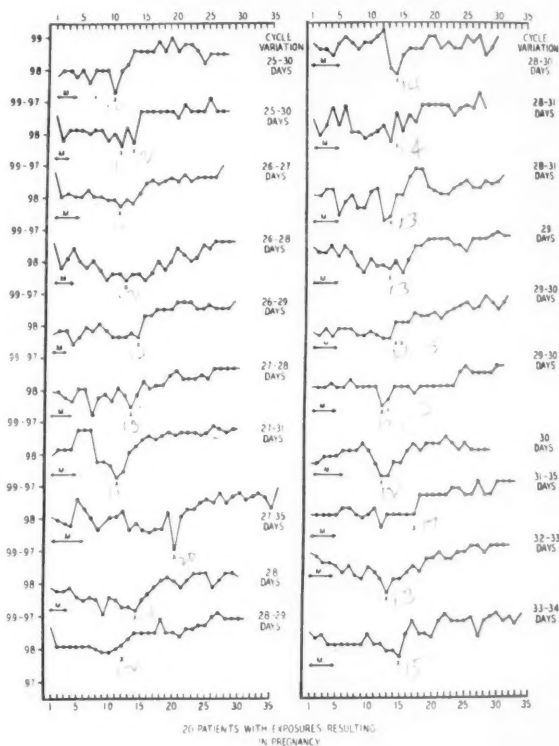


Fig. 4.

the records of these two women one may hazard the suggestion that when nausea occurs it starts at the date of the midperiod following conception.

Fig. 4 gives the record of the last menstrual cycle in each of 20 women to illustrate identification of ovulation with approximate date of the midperiod low temperature. No pregnancy occurred before the tenth day or after the twentieth day of the cycle regardless of cycle

length. In no woman did pregnancy occur more than three days before or one day beyond the initial rise of temperature from the midperiod low level. After conception the temperature no longer undergoes a cyclic change except in those few women who menstruate or perhaps even ovulate after pregnancy starts. The temperature during pregnancy remains high as in the last part of the menstrual cycle and can be used as a sign of pregnancy before other methods of diagnosis are positive. From the records of these women we find it possible to diagnose pregnancy also by a persistent tenderness of the breasts more pronounced than that usual in the premenstrual days. This exaggerated

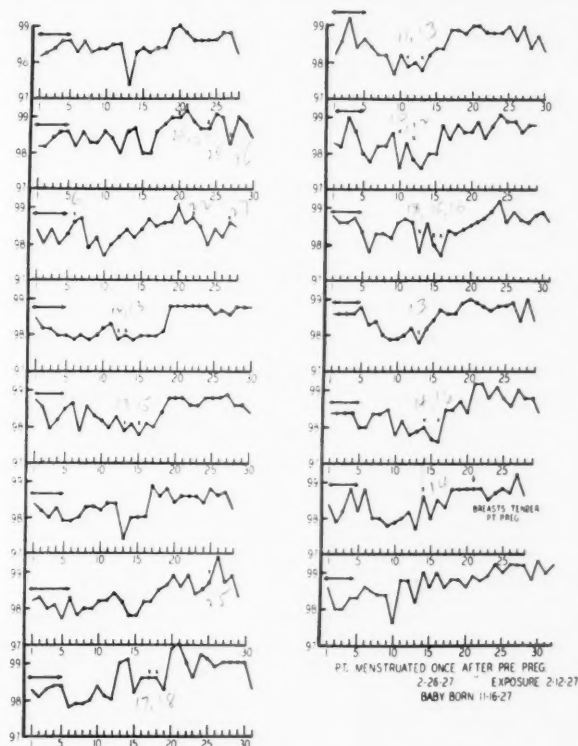


Fig. 5.—The temperature and exposure records of one woman over fifteen menstrual months preceding pregnancy to illustrate the close relationship between exposure and midperiod low temperature with its implied ovulation which must be fulfilled in order to ensure conception.

tenderness always appears before the missed menstrual period. In one woman it occurred on the fifth day after exposure, a finding which suggests an occasional earlier date for implantation than the tenth day after fertilization as claimed by Hartman.⁹

In every woman the morning nausea started at what by computation would be the date of the next ovulation after conception. Hence morning sickness of pregnancy may be related to a change in the ovulation cycle.

Fig. 5 represents the temperature and exposure records of one woman over fifteen menstrual months preceding pregnancy to illustrate the

close relationship which must be fulfilled between exposure and mid-period low temperature with its implied ovulation in order to ensure conception. Exposure has apparently little chance of prematurely rupturing the ovarian follicle, since this woman had exposures in several months on the day before the temperature rise began but pregnancy did not ensue. She became pregnant, however, the first time she had an exposure on the day after the rise began. This would indicate that the viability of the sperm is less than twenty-four hours.

In other women studied, repeated exposure just after the low temperature level failed to produce pregnancy; this indicates a viability of the ovum of not more than thirty-six hours.

It will also be observed from this record that a subsequent full menstruation occurred after pregnancy had started and that conception took place fourteen days before the onset of the period. This particular woman also menstruated once after a preceding pregnancy.

The human fertile period is herein shown to vary from woman to woman and from cycle to cycle. It is necessary to study each woman's variation in order to understand her particular variability. As a simple method of determining the time of ovulation, the basal rectal temperature is offered, since it is a procedure which is easy to follow and since it bears a close relationship to the time of ovulation as shown by the above reported case records.

SUMMARY

1. In 35 cases herein reported conception occurred from the tenth to the twentieth days of the menstrual cycle regardless of cycle length.

2. Basal body temperature is a guide to the period of fertility as identified in these studies to occur not more than three days before or one day after the midperiod of the menstrual cycle, with a high incidence at the time of the last low temperature before the lutein phase begins.

3. Breast tenderness of unusual severity occurs before the missed menstrual period, and the morning sickness of pregnancy begins at the time of the next ovulation period after conception starts.

4. The viability of both sperm and ovum is short, probably not exceeding twenty-four hours.

5. Intercourse does not cause follicle rupture.

6. Ovulation and menstruation may occur after conception begins.

7. Studies of basal body temperature may be used as a guide or forecast of unusual ovulations or to supplement other data in studying sterility. There is advantage in this type of study where menstrual physiology is obscure.

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EXCRETION OF HORMONES IN A CASE OF HABITUAL ABORTION*

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THE purpose of this report is twofold; first to present the urinary estrogenic and gonadotropic hormone findings in a carefully followed case of abortion, and second, to confirm the findings of a report by Cohen and others,¹ and Marrian² in which an association between the sudden excretion of free fat-soluble estrogenic hormone and the onset of labor was demonstrated.

The patient studied was a woman of 36 years, anxious to have a child but with the history of two spontaneous abortions at 1.5 and 5 months and one premature labor at 6.5 months in the order noted. The latter pregnancy terminated spontaneously Jan. 8, 1936. It was planned at that time that the patient should collect complete twenty-four-hour urine specimens regularly at weekly intervals during the ensuing year and bring them to the laboratory for the assay of estrogenic and gonadotropic hormones. She was to avoid pregnancy for the first six months of this experiment. This plan was carefully followed. A daily record of intercourse and menstrual periods was kept.

The intervals at which coitus occurred, the date of abortion, and the size of the fetus were such that the probable date of conception could be quite accurately calculated. Unfortunately for the patient the pregnancy under investigation was multiple (twins) and an examination within a few hours after the earliest symptoms of abortion revealed a bulging amnion filling the vaginal vault. The patient promptly aborted twins and subsequently recovered after a stormy four-day febrile reaction.

*Supported by the Christine Breen Fund for Medical Research.

METHODS

Estrogenic hormone determinations were done exactly as described in previous reports.^{3,4} The urine was not extracted for "free" estrogenic hormone, however, until the sixth week of pregnancy. In all instances the estrogenic hormone was calculated as estrone in gamma excreted per day.

Gonadotropic hormone determinations were done each week according to a concentration method described by Freed and Hechter,⁵ until the hormone characteristic of pregnancy first became evident. After pregnancy was established the whole and diluted urine was tested for its gonadotropin content. A mouse unit of the gonadotropic hormone characteristic of pregnancy is the least amount of hormone necessary to produce at least one corpus luteum in at least one ovary of a nineteen to twenty-one-day-old female mouse 100 hours after injection. The amount excreted per day was calculated from the twenty-four-hour volume of urine.

DISCUSSION

As noted in the chart the first positive pregnancy reaction was obtained at the end of the second week of pregnancy, which date should have been the day of onset of the first missed menstrual period. The first demonstrable excess in the excretion of estrogenic hormone occurred at the end of the sixth week of pregnancy. The early appearance of the gonadotropic hormone characteristic of pregnancy as compared with the later appearance of increased amounts of estrogenic hormone is of importance in understanding why pregnancy tests which depend upon the detection of gonadotropic hormone are of greater value in early pregnancy than those tests which depend upon the detection of increased excretion of estrogenic hormone.

The peak of gonadotropic hormone excretion occurred at the end of the sixth week of pregnancy. The amount is in agreement with the reports of other investigators.⁶⁻⁹ Although the patient experienced morning nausea, the latter did not seem to have a clear-cut association with the peak of gonadotropic hormone excretion.⁶ This marked excretion of gonadotropic hormone demonstrates the impossibility of making a diagnosis of hydatidiform mole and chorioepithelioma on the basis of quantitative hormone excretion during the first trimester.

The fall of gonadotropic hormone excretion during the eighth and ninth weeks, followed by a second rise, has not been reported previously. Similar studies of habitual abortion may help to determine whether or not this phenomenon may be associated with a patient's tendency to abort.

The urine concentration procedure failed to reveal any of the gonadotropic hormone in the urine later than the fifth day post partum.

Five days before the patient aborted, the excretion of estrogenic hormone fell far below the expected gradually rising level known to occur in normal pregnancy. Could this have been known on the day of its occurrence, some form of hormone therapy might have prevented the termination of pregnancy. Chemical tests for estrogenic hormone which may be done quite rapidly are not, as yet, of definite value so early in pregnancy.

With reference to the second point in the purpose of this report, namely the confirmation of findings reported by Cohen and others,¹ the

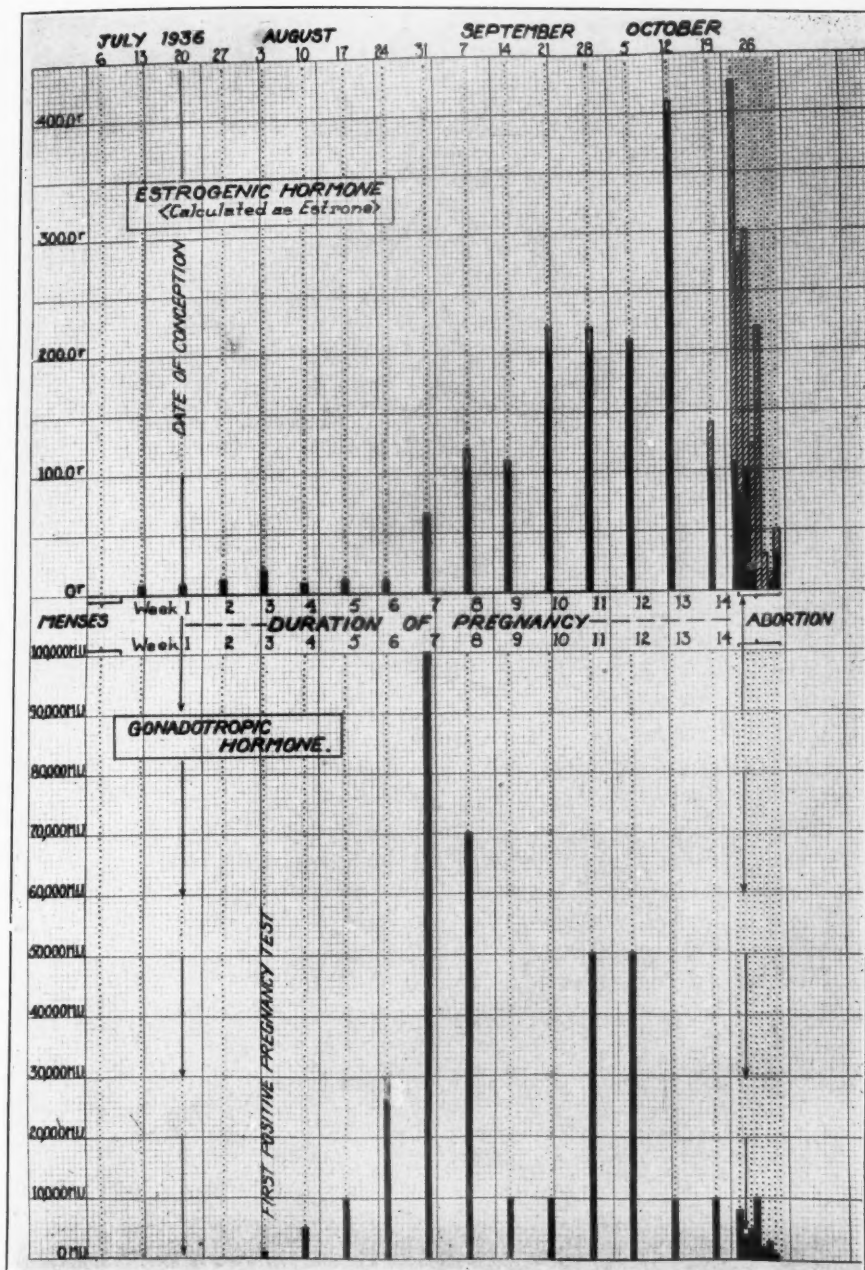


Chart 1.—*Estrogenic Hormone*: The columns represent the total excretion of estrogenic hormone per twenty-four hours on the days indicated. The solid portion of the column represents the "combined" fat-insoluble hormone, and the shaded portion of "free" fat-soluble hormone. Each is calculated as estrone. *Gonadotropic Hormone*: The columns represent the total excretion of the gonadotropic characteristic of pregnancy per twenty-four hours on the days indicated. In every instance the assay was done on a portion of the same twenty-four-hour urine specimen used for estrogenic hormone determination. A mouse unit is the least amount of hormone necessary to produce at least one corpus luteum in at least one ovary of a nineteen to twenty-one-day-old female mouse 100 hours after injection. The amount excreted per day was calculated from the twenty-four-hour volume of urine.

sudden excretion of increased amounts of "free" fat-soluble estrogenic hormone preceded and accompanied parturition. Cohen fractionated the fat-soluble estrogenic hormone into estrone and estriol for purposes of chemical identification. This procedure does not, at the present time, lend itself well to biologic means of testing. The "free" estrogenic hormone shown in the accompanying chart represents both estrone and estriol whose joint estrogenic activity is calculated as estrone.

It should be stated that the small amounts of "free" hormone excreted from the seventh week until the week during which parturition occurred are probably of no significance. Although each specimen was extracted within twenty-four hours of its collection, slight bacterial hydrolysis of "combined" hormone is known to occur in the urine upon standing at room temperature. The time factor is a constant one in this laboratory.

The rather marked fall in urinary hormone excretion at the onset of labor is in keeping with a suggestion made in a previous report,⁴ namely that the uterus may be considered an excretory organ for estrogenic hormone.

SUMMARY

The quantitative hormone determinations and discussion pertaining to them in a case of habitual abortion are presented. The relationship of estrogenic hormone excretion to parturition is demonstrated.

CONCLUSIONS

1. Parturition is accompanied by a sudden urinary excretion of "free" fat-soluble estrogenic hormone.
2. The diagnosis of hydatidiform mole or chorionepithelioma cannot be made from the quantitative determination of gonadotropic hormone excretion in the urine during the first trimester.

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The author feels that the first stage of labor begins not when uterine pains begin but during the last few weeks of pregnancy, with a slow and gradual formation of the lower uterine segment. Undivided control over the latter weeks of pregnancy and the succeeding labor would serve greatly to lessen complications. Quinine is recommended for prophylactic use where a uterine inertia is threatened in the first stage. He recommends Dührssen's incisions or spinal anesthesia and manual dilatation for the slowly dilating cervix.

F. L. ADAIR AND JOHN A. HAUGEN.

GENERALIZED PERITONITIS SECONDARY TO RUPTURED PYOSALPINX

WITH THE REPORT OF TWO CASES

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GENERALIZED peritonitis secondary to chronic pelvic inflammatory disease may occur by one of two methods: The purulent material may be expressed from the patent fimbriated ostium of the tube and then spread over the general peritoneal cavity, or the material may be suddenly discharged by rupture of a pyosalpinx. It is the latter condition which forms the basis of this paper. Here the infection starts as an endosalpingitis, usually caused by the gonococcus. The tube then becomes sealed off at both ends and undergoes increasing distention until it becomes a cystic mass containing pus. The pyosalpinx may then burst either spontaneously or as a result of some slight, indirect trauma, liberating its purulent material into the general peritoneal cavity.

The purpose of this paper is to emphasize the clinical syndrome associated with this condition, and to offer suggestions for its treatment, based on a survey of the cases previously reported.

HISTORY

Gendrin¹⁰ in 1833, was the first to observe that rupture of a pyosalpinx may give rise to a generalized peritonitis. In this case, reported in 1844, the pyosalpinx was probably not of gonorrheal origin, but rather secondary to a septic abortion which preceded the perforation. Later, in 1861, M. Chipault⁶ presented a case before the Société Anatomie de Paris; here the pyosalpinx was probably caused by an advanced carcinoma of the cervix which the patient presented, and not by a gonorrheal infection. The following year before this same society, Almagno¹ presented the autopsy findings of a case of generalized peritonitis secondary to rupture of an enormously distended pus tube. This case too, was probably of postabortal, rather than gonorrheal origin. Lawson Tait²² in 1889, described a case seen twenty years previously, of ruptured pyosalpinx, which he attributed to the repeated use of mechanical pessaries.

The first case of gonorrheal pyosalpinx to be reported was that of Lawson Tait.²³ This was not, however, a spontaneous rupture but occurred during the course of labor. The patient was thought to have "puerperal fever" until autopsy disclosed her death to be due to rupture of a gonorrheal pyosalpinx, occurring during labor. The first reported case of gonorrheal pyosalpinx rupturing spontaneously should be attributed to Bernutz,²⁴ who read his paper before the Société Anatomique, on Jan. 16, 1880. During the same year, Janeway¹² in this country, reported a similar case discovered at autopsy. In 1913, Norris¹⁹ summarized the literature to that time and brought the total reported cases to 97. Subsequently, infrequent reports of this condition have appeared in the American literature. Petroff²⁰ in 1932 collected 102 cases from the French literature. In 1935, Soimaru²¹ reported five cases seen in a short time. In Germany, Lübke¹⁶ reported 34 cases seen at the Eppendorf clinic between 1900 and 1934. The sum total of these cases in the literature brings the total to approximately 238. This figure probably grossly underestimates the exact frequency of this condition. There are perhaps a considerable number of cases not recognized clinically, or recognized, but not reported.

Incidence.—Compared with other varieties of complication of gonorrhea in the female, rupture of a pyosalpinx is rather infrequent. Norris¹⁹ states, "Rupture or perforation of an adherent pyosalpinx into the rectum is not infrequent and into the bladder or upper intestine is more rare. Rupture into the peritoneal cavity seldom occurs." Curtis⁷ in his recent text, states, "The danger of tubal rupture comparable with rupture of the diseased appendix, is sometimes emphasized to patients as a reason for surgical intervention. The possibility of this complication is remote. I believe it has not occurred in any of our patients." Yet from the two cases seen by us in a two-year period, and a statistical survey of the literature, it would appear to be a not infrequent occurrence and one certainly to be kept in mind, for upon its early recognition depends a good prognosis.

Lenormand and Kaufman¹⁵ state that of 560 patients with all types of salpingitis operated upon, there were 5 in which rupture of the tube was noted, giving an incidence of approximately 1 per cent. But, of the patients with generalized peritonitis operated upon due to all causes, five were caused by ruptured pyosalpinx, giving an incidence of 8 per cent. Similarly, Bauer² in the Scandinavian literature reported 138 cases of generalized peritonitis, 115 of which were due to appendicitis, 13 to ruptured ulcer, and 10 to perforation of the pyosalpinx, giving again an approximate incidence of 8 per cent to all cases of generalized peritonitis.

ETIOLOGY

Immediate Cause for Rupture.—In the majority of cases, there is no assignable cause for rupture, i.e., it occurs spontaneously, as in the two cases to be reported. Of the 102 cases gathered by Petroff²⁰ 56 cases occurred spontaneously. In these cases, it is the increasing distention of the pus tube by the acute inflammation with secondary ulceration of the wall of the tube which is the predisposing factor which leads to the perforation.

In a minority of cases, some form of direct or indirect trauma is immediately responsible for the perforation. Among these direct acts of violence may be a kick or blow on the vulva, perineum or lower abdomen, or ill-advised or too vigorous bimanual examination (Leguey,¹⁴ Martin¹⁸) or violent coitus or trauma incident to a curettage which is subsequently diagnosed as a puerperal infection. Among the indirect causes of trauma responsible for the rupture, may be mentioned the pregnant uterus, which as it enlarges, pulls up and thins out an adherent inflammatory tube, or labor itself, with its incident muscular efforts (Tait²³). Other indirect exciting causes are straining, lifting, or the use of violent purgatives (Janeway¹²) or transportation to a hospital (Mann¹⁷).

Age.—The age period during which the condition was found to occur most frequently is that period when active pelvic infection is most common, namely, between the ages of twenty and forty years. In Petroff's 102 cases, 66 per cent occurred in this age group, with extremes of sixteen and fifty-four years.

Size, Location, Duration of Pyosalpinx and Point of Perforation.—No rule can be made as to the size the pyosalpinx must attain before it is likely to rupture. In many of the reported cases, they have been small, and in others the pyosalpinx attained a large size. Nor are there sufficient data in many of the reports to determine the duration of the pyosalpinx and the number of attacks that have occurred prior to rupture. It is true that recent acute exacerbations of the chronic pelvic disease undoubtedly predispose to rupture by bringing about an increasing distention and ulceration of the pus tube.

Interestingly enough, rupture occurs somewhat more frequently on the right side than on the left, although in all cases, the opposite tube is also diseased. Brickner⁵ states that rupture occurred 33 times in the right tube and 23 times in the left, and Petroff gives 54 cases as occurring on the right side and 42 on the left. The perforation occurs most frequently in the ampullary end of the tube and the size of

the perforation may be from a few millimeters to several centimeters in diameter.

Organism.—In practically all cases of chronic pelvic disease, it is the gonococcus which is the primary offending organism. Subsequently, however, in its development, the pyosalpinx becomes secondarily infected with other organisms. The actual causal relationship of the gonococcus to the pyosalpinx has been difficult to demonstrate because of the overwhelming growth of these secondary invaders, because of the death of the gonococcus when the tube becomes sealed off at both ends, or perhaps because of the difficulty in culturing this organism. It is the secondary invasion of the pyosalpinx by other pathogenic organisms, that makes perforation so frequently fatal.

Brickner⁵ in a study of 91 cases, found 11 cases of perforated pyosalpinx to be of gonorrheal origin. Petroff found that of 17 cases examined bacteriologically after perforation, the *Streptococcus hemolyticus* and the colon bacillus were most common and that the gonococcus was present in only one case. Of Lübke's¹⁶ 34 cases, the gonococcus was demonstrated in two cases.

SYMPTOMS AND DIAGNOSIS

The symptoms vary widely, but for the most part, there is a definite clinical syndrome associated with ruptured pyosalpinx that can be diagnosed without difficulty. The onset is usually very abrupt and violent and the symptoms progress very rapidly, starting with a sudden sharp pain in the lower abdomen most marked over the site of the lesion, followed by the rapid development of a diffuse peritonitis with more or less marked collapse, a symptom complex, not unlike that of a ruptured ectopic pregnancy. Frequently, there are nausea and vomiting, associated with pallor and profuse perspiration. The patient complains of being chilly, and the extremities are cold. The temperature is normal or subnormal for a few hours with a coexisting rapid pulse. This disproportion between the temperature and the pulse rate in the early stage, is a suggestive sign. The temperature soon rises and other evidences of peritonitis rapidly become manifest. The abdomen shows at first, generalized marked rigidity, and later, abdominal distention. There is a definite leucocytosis of 12,000 to 20,000 white blood cells, and an elevated erythrocyte sedimentation rate.

The diagnosis, if one bears in mind the clinical picture, is not at all difficult, especially if one had examined the patient before rupture and knows the condition of the adnexa, their size, shape, and consistency. The history of the case, especially if there had been a previous gonorrheal infection and prolonged sterility, a careful abdominal and pelvic examination with special emphasis on signs of chronic gonorrhea, the disproportion between the temperature and pulse at the start with a subsequent mounting temperature, and signs of general peritonitis, together with a leucocytosis and an elevated erythrocyte sedimentation rate, should aid one in arriving at a correct diagnosis.

This condition may be confused with simple acute exacerbation of a chronic pelvic disease, torsion or rupture of an ovarian cyst, ruptured tubal pregnancy, and ruptured appendix. Rupture of a pyosalpinx may be distinguished from an acute exacerbation of a chronic salpingitis by the greater severity of its symptoms, the diffuse character of the infection, with the signs of collapse, and an increased sedimentation rate. Curiously enough, with an overwhelming infection in the form of a generalized peritonitis associated with the ruptured pyosalpinx, the sedimentation rate appears to be slower than in localized simple acute salpingitis.

The clinical picture of torsion or rupture of an ovarian cyst is very similar to that of a ruptured pyosalpinx. This, however, it should be easy to differentiate by a careful history and pelvic examination, noting the presence or absence of gonorrhea in the lower genital tract.

A ruptured tubal pregnancy offers difficult problems in differential diagnosis. In this condition however, one does not often find evidence of chronic pelvic inflammatory disease, hyperpyrexia, or marked abdominal rigidity, but does find evidence of an internal abdominal hemorrhage and secondary signs of early pregnancy.

A number of cases of ruptured pyosalpinx have been mistaken for ruptured appendicitis with generalized peritonitis, but the history in the latter, before perforation is very important. Fortunately the treatment of all of these cases for which rupture is likely to be mistaken, is the same, namely operation.

TREATMENT

The treatment of cases of ruptured pyosalpinx as seen from a study of the cases in the literature is primarily surgical. All cases of ruptured pyosalpinx, or those suspected as such, should be subjected to immediate operation. There is no single case on record of survival without operation. Of the 91 cases collected by Brickner⁵ in 1912, 36 patients were not operated upon and all died.

As to the nature of operation to be performed, it appears from Table I that salpingectomy is the procedure of choice, for it is associated with the lowest mortality.

TABLE I. OPERATIVE PROCEDURES AND RESULTS

NATURE OF OPERATION	NUMBER CASES	DIED	MORTALITY PER CENT
1. <i>Drainage Alone:</i>			
Petroff ²⁰	9	6	66
Soimaru ²¹	5	3	60
2. <i>Unilateral or</i> <i>Bilateral Salpingectomy:</i>			
Petroff ²⁰	46	10	21
Soimaru ²¹	28	3	11
Duval ⁹	12	1	9
3. <i>Subtotal or Total</i> <i>Hysterectomy:</i>			
Petroff ²⁰	30	7	23
Soimaru ²¹	11	4	36

Bilateral salpingectomy with removal of all of the diseased tissue, appears to be a safer procedure than a unilateral salpingectomy alone, for it is associated with a lower mortality rate. (Petroff,²⁰ 11.8 per cent against 27.5 per cent.) Adequate drainage from the pelvis should be instituted by Mikulicz' drain or rubber tube drain. It is only with such treatment that these patients having a ruptured pyosalpinx may be saved.

PROGNOSIS

From a review of the cases previously reported in the literature, it is interesting to note that the general mortality in all cases of ruptured pyosalpinx has gradually and progressively declined. This is well illustrated in Table II which shows the original mortality of 50 to 60 per cent to have declined to approximately 20 per cent in the course of the last twenty-five years.

The prognosis in any given case depends on a variety of factors. It is generally agreed by all authors that one of the most important factors is the time at which surgical treatment is instituted. There is not a single case on record of recovery without surgical intervention, and most

TABLE II. MORTALITY STATISTICS

AUTHOR	YEAR	CASES	NUMBER DIED	MORTALITY PER CENT
Bonney ³	1909	45	22	48
Bovée ⁴	1910	56	32	57
Brickner ⁵	1912	91	56	61
Lamouroux ¹³	1912	27	9	33
Lübke ¹⁶	1924	34	14	41
Duval ⁹	1929	14	1	7
Petroff ²⁰	1932	102	28	27
Soimaru ²¹	1935	5	1	20

patients operated upon after forty-eight hours from the onset of the acute symptoms, die. The duration of survival without operation may be anywhere from a few hours to three and one-half months, with an average of fifty-nine hours.

The percentage mortality in all cases of ruptured pyosalpinx varies directly with the length of time before surgical intervention. In Brickner's⁵ series of those operated upon within twelve hours, 10 per cent died, and 90 per cent recovered. Similarly, in Lübke's series, the percentage mortality was 27 per cent in those operated upon within the first twelve hours. Huet¹¹ gives 10 per cent mortality and Petroff²⁰ gives 18 per cent mortality, with a corrected mortality of 11.8 per cent within this twelve-hour period. The mortality, however, in the operative cases rises rapidly with each hour elapsing, as shown by Petroff²⁰ in Table III.

TABLE III. MORTALITY ACCORDING TO TIME OF OPERATION (AFTER PETROFF²⁰)

HOUR OF SURGICAL INTERVENTION	NO. CASES	NO. RECOVERIES	NO. DIED	MORTALITY PER CENT
Before 12 hours	34	28	6	18
Between 12 and 24 hours	20	15	5	25
Between 24 and 48 hours	9	6	3	33
After 48 hours	11	3	8	73

The only reason for Duval's excellent results (Table II) is the fact that those who survived were operated upon from six to forty hours after perforation, and the one patient that died had the perforation eight days prior to operation.

Another important factor upon which the prognosis depends is the type of surgical procedure instituted. The operation which is rapid and carried out with a minimum of trauma and manipulation and yet removes the entire pathology, is the procedure of choice. And this has been found, by all authors, to be a unilateral or bilateral salpingectomy with drainage. If other procedures are instituted at the time of operation, the mortality is much higher.

The character of the predominating organism is only of secondary prognostic importance. Generally, the streptococcus and the colon bacillus are most virulent and the cases in which the pus is sterile, or contains the gonococcus or staphylococcus, have a better prognosis. Of 11 patients operated upon within twenty-four hours, and in which the pathogenic organism was known, in Petroff's series,²⁰ all, except one, lived regardless of the character of the organism (and there were four which showed streptococci, others with colon bacilli, and colon bacilli

plus staphylococci and gonococci). In the patient who died, a streptococcus was recovered, but the patient died of postoperative hemorrhage following a second operation. On the other hand, of those patients operated upon after twenty-four hours, one patient who was infected with the colon bacillus lived and 5 others died. Of the latter there were 3 cases which showed streptococci, 1 enterococci, and 1 in which the organism was not identified. Of course, those cases in which the pus was sterile (1 case, and 5 cases in Lübke's series) survived, regardless of the time of operation.

It appears therefore, that for the most part, the prognosis depends upon, (1) the general state of the patient, (2) the time of surgical intervention, (3) the nature of the operation instituted, and (4) to a lesser extent, the bacteria present at the time of perforation.

REPORT OF CASES

The following is a report of the 2 cases observed in two successive years at Cumberland Hospital.

CASE 1.—History.—E. R., a 35-year-old white female, was admitted April 4, 1934 with the history of an onset of generalized cramplike pains associated with constipation, ten days prior to admission. For five days prior to admission, the patient had persistent vomiting associated with the abdominal pains. The day before admission she had had a bowel movement following an enema. Her menstrual history had always been regular; the last regular period started on March 22, 1934, and lasted one week as usual. She had again begun to bleed, however, five days prior to admission; this period came two weeks too early and was associated with a more profuse flow. Her past history revealed she had been married sixteen years, but had never been pregnant.

Examination.—On admission, the patient was anxious, in severe shock, and had cyanosis of the lips and nail beds. Her skin was cold and clammy, the pulse feeble, and her blood pressure unobtainable. The abdomen was markedly rigid in both lower quadrants with severe tenderness, especially in the left lower quadrant. Vaginal examination showed the cervix to be normal; the uterus was retroverted. There was tenderness in the right fornix and a tender mass was found obliterating the left fornix. The cervix was not tender to motion. Rectal examination disclosed a tender mass in the posterior cul-de-sac.

Laboratory Data.—There was a leucocytosis of 18,000 white blood cells, with the polymorphonuclear leucocytes 92 per cent. The sedimentation rate was 18 mm. in sixty minutes (normal, over two hours). The urine had numerous casts, epithelial cells, and white blood cells, albumin 2-plus, acetone 1-plus. Blood chemistry revealed urea nitrogen of 54.4 mg. per cent. Temperature on admission was 104° F. and subsequently rose to 106° and 107° F.

Course.—The patient remained in extreme shock in spite of active treatment with stimulants and parenteral fluids. She continued to vomit, and died ten hours after admission.

Autopsy Findings.—Autopsy revealed an acute diffuse suppurative peritonitis with a cul-de-sac abscess. There was an acute suppurative left salpingo-oophoritis with perforation, with an acute suppurative right salpingitis. The lungs revealed an interstitial pneumonia and atelectasis in both lower lobes.

Comment.—It is interesting to note that this woman gave a history of sterility of sixteen years duration. She probably sustained her gonorrheal infection very early in married life, following which she became sterile. She then harbored the chronic salpingitis until this acute exacerbation with perforation which ended in diffuse peritonitis and death. The history of obstinate constipation is interesting, and it was not infrequently met with, in the cases presented in the literature.

The purgation in an attempt to overcome the constipation was the final precipitating factor in bringing about increased congestion, engorgement, and finally perforation. The shock seen in this case was profound and is typical of the condition. The hyperpyrexia was preagonal though at the time of perforation, the temperature is usually normal or subnormal. The elevated urea nitrogen was probably of extrarenal origin resulting from dehydration secondary to the persistent vomiting of five days duration. Her condition on admission, which was ten days after the onset of the fulminating peritonitis, precluded any possible surgical intervention, and she died shortly afterwards.

CASE 2.—First Admission: History.—M. T. was first admitted on May 11, 1934 with a history of onset of sharp pain in the right lower quadrant, eleven days prior to admission, spreading gradually over the entire abdomen and associated with chills and fever. Her menstrual history was normal. She gave a history of vaginal discharge and dysuria of several years duration. One year prior to admission, a routine Wassermann was found to be positive and the patient was given six intramuscular injections.

Course.—The patient was placed on a course of Elliott treatments following which the pain and tenderness gradually subsided and she was discharged on May 24, 1934, with residual though no longer tender masses in both fornices. Her sedimentation rate was still rapid (18 mm. in fifteen minutes).

The patient was readmitted on Oct. 19, 1936, in a comatose condition with a history of having had abdominal pains with high fever, and persistent vomiting for four days prior to admission. According to the history obtained from her husband, she had become comatose and weak on the morning of admission.

Examination.—Physical examination at this time showed the patient to be in coma and shock with her extremities cold, though not perspiring. Her pupils were small and did not react to light. Blood pressure was 80/60, pulse 120 per minute, feeble and easily compressible. Heart sounds at the apex were poor. Examination of the abdomen was unreliable because of the patient's poor reaction to stimuli. There was rectus rigidity on the right side and lower abdomen, with questionable rebound tenderness. Vaginal examination disclosed the presence of sausage-shaped freely movable masses in the right fornix. On the left side there was a hard irregular mass of indefinable outline, which was apparently continuous with a mass in the anterior vaginal wall.

Laboratory Data and Course.—There was a leucocytosis of 13,200 white blood cells, with 86 per cent polymorphonuclear leucocytes. The sedimentation time, done by the same method as on previous admission, was now one hour. Urine showed 2-plus albumin. Routine blood chemistry revealed the sugar to be present in a concentration of 26 mg. per cent, and urea nitrogen 76.9 mg. per cent. The patient was given 50 c.c. of 50 per cent glucose intravenously, and five minutes later was sitting up in bed giving a fairly intelligent history. Her blood sugar at this time was 50 mg. per cent. She remained conscious but in a state of shock with blood pressure ranging between 70 and 90 mm. mercury systolic and 30 to 60 diastolic, and rapid pulse, in spite of continued administration of parenteral saline and glucose. On the third day after admission, the patient's condition improved and she appeared to be recovering from shock, but on the following day she presented signs of pneumonia in both lower lobes, and she died on the sixth day after her admission, with a terminal temperature of 106° F.

Autopsy Findings.—Autopsy revealed a generalized peritonitis secondary to a bilateral salpingitis with perforation of a right pyosalpinx. The pancreas was sclerotic and contained an adenoma of the islands of Langerhans. Lungs showed a terminal bronchopneumonia.

Comment.—This case is interesting in that the patient was treated at the hospital for an acute salpingitis, two years prior to the time of her perforation, and was discharged "improved" only to return with this fatal complication. The clinical picture of the second admission for the perforated pyosalpinx was both obscured and complicated by the presence of the adenoma of the pancreas, giving rise to the

hyper-insulinism, hypoglycemia and its incident coma. The hypoglycemia reacted spectacularly to the administration of glucose intravenously, but the shock, incident to the abdominal calamity, persisted for two days. This ultimately was complicated by a terminal bronchopneumonia and the patient died ten days after the onset of the acute symptoms. In this second case, the diagnosis of peritonitis secondary to ruptured pyosalpinx was entertained, but the additional findings of hypoglycemia with its immediate improvement upon the administration of glucose, followed by the signs of pulmonary involvement complicated the picture and made surgical intervention inadvisable. It was not until after the autopsy that the entire clinical picture was understood.

DISCUSSION

These two cases present the classical syndrome of generalized peritonitis secondary to spontaneous rupture of a pyosalpinx. There is a history of a sudden abdominal calamity starting as a sharp abdominal pain associated with persistent vomiting. On admission to the hospital, signs of severe shock, with evidences of an "acute abdomen" are found. Both patients present marked abdominal rigidity, tenderness, and rebound tenderness. In addition, vaginal examination reveals evidence of an old pelvic infection. There are a leucocytosis and an increased sedimentation rate in both cases, as well as a preterminal rise in temperature.

SUMMARY

1. The history of generalized peritonitis secondary to ruptured pyosalpinx is briefly reviewed.
2. Although not a common complication of gonorrhea in the female, rupture of a pyosalpinx accounts for 8 per cent of all cases of generalized peritonitis.
3. In the majority of cases of spontaneous rupture of a pyosalpinx, there is no assignable cause for the perforation. There is no strict correlation between perforation and the number of acute attacks of salpingitis or the size of the pyosalpinx.
4. The diagnostic features consist of a sudden onset of a diffuse and rapidly spreading peritonitis associated with a state of circulatory collapse, followed by a rapidly rising temperature, a leucocytosis and an elevated erythrocyte sedimentation rate.
5. The treatment of choice of this condition is a bilateral salpingectomy followed by the insertion of a Mickulicz' or tube drain into the pelvis.
6. The prognosis depends upon the general state of the patient, the time of surgical intervention, the nature of the operation instituted, and to a lesser extent, the bacteria present at the time of perforation.
7. Two cases of generalized peritonitis secondary to spontaneous rupture of a pyosalpinx are here presented and discussed.

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TUBERCULOSIS OF THE CERVIX

WITH REPORT OF A SO-CALLED PRIMARY CASE

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THE purpose of this paper is to report 18 cases of tuberculous cervicitis, one of which is definitely primary in the genital tract, and apparently the only active lesion in the patient. Tuberculosis of the cervix is very rare and is of interest because it clinically may resemble carcinoma of the cervix, and, if secondary to other genital or extra-genital tuberculosis, announces the presence of the infection. If it is the only tuberculous lesion in the genital tract it may indicate tuberculous epididymitis in the marital partner.

In 1919 Moore³³ stated that there were probably not more than 20 undoubted cases of primary tuberculous cervicitis, and in the tabular summary of Counsellor and Collins¹¹ in 1935 this number was reduced to 11. Further study on two of these has shown them to be secondary and thus only 9 true cases remain. The reason for the decrease in number of cases is the increasing exactness of definition accorded the term "primary." In some instances the infection is the first or only tuberculosis in the genital tract, and many authors have reported primary cases on this basis. The most recent writers interpret the term as meaning the primary lesion in the patient, which allows its etiology to be exogenous only. This is as it should be, for the term "primary," when used in connection with tuberculosis, should refer only to the classical early or primary lesion occurring in the lung. Thus an old inactive pulmonary scar must count as the primary lesion, even though the cervix contains the only active focus of tuberculous infection. Since a large percentage of our population is early infected with pulmonary tuberculosis, the occurrence of a true primary tuberculous cervicitis is an improbability. The author wishes to report his case as one of tuberculosis of the cervix, with this being the only focus of this infection in the genital tract.

* * * * *

The history of tuberculosis of the cervix can be traced through the papers of Reynaud,³⁹ who reported the first case in 1831, Boivin and Dugés,⁶ Geil,²⁰ Virchow,⁴⁵ Rigal,⁴⁰ Cohnheim,¹⁰ and Babes.¹ More recently the literature on this disease has been summarized by Beyea,⁴ Murphy,³⁴ Moore,³² Greenberg,²¹ Counsellor and Collins,¹¹ and, in 1936, by Finlayson.¹⁹

In the Department of Pathology of the Johns Hopkins Hospital and Medical School, 0.9 per cent of all autopsies on women have shown genital tuberculosis.

From the literature we find that from 5 (49) to 12 per cent (31) of the women dying of tuberculosis have involvement of the genital tract. The cervix is said to be involved in from 3.5 (22) to 8 per cent (47) of the cases of genital tract tuberculosis. Because of the almost universal practice of supracervical hysterectomy in pelvic inflammatory disease Jameson (of Saranac)²⁶ feels that these figures on the frequency of occurrence of tuberculous cervicitis are probably too low. There have been 18 recognized cases of tuberculosis of the cervix in the Gynecological Pathology Laboratory of the Johns Hopkins Hospital, one of which is, as far as we can determine, the sole lesion in the genital tract. These have been found in the 307 cases of genital tract tuberculosis in our laboratory, thus establishing an incidence of 6 per cent for cervical involvement in this genital tract disease. In Greenberg's paper from our laboratory²¹ two cases which were reported as apparent "primary" tuberculosis of the cervix have since been found, through further study, to be secondary to upper genital tract tuberculosis.

Finlayson¹⁹ reviewed the work on experimental implantation of tubercle bacilli in the lower genital tract of animals and concluded that the cervix does not usually become infected unless there is trauma or previous inflammation with erosion. As the result of vaginal inoculations in sensitized guinea pigs, Jameson²⁷ has concluded (1) that a break in the mucosa is not necessary for infection, (2) that the bacilli probably penetrate it through the interstices of the epithelial cells, (3) that they then establish themselves in the submucosa and spread through it by lymphatic extension, and (4) later ulcerate back through the epithelium into the vaginal cavity.

Cohnheim¹⁰ suggested coitus with a male with genital tuberculosis as a cause of primary genital tract tuberculosis in the female, but tubercle bacilli have apparently never been demonstrated in the semen of living human beings. There has been no undoubted so-called "primary" cervical tuberculous infection reported in a virgin, all definite ones having occurred in married parous women or in those given to sexual excesses. Finlayson, Chaton, and Bender have described cases where the infection arose shortly after parturition. Finlayson reports four cases in which tuberculosis of the vulva or vagina occurred simultaneously with cervical tuberculosis, and he believes that the cervix was the primary site in one of them. Jameson²⁸ states that upper genital tract tuberculous infections generally are descending ones and very rarely extend below the internal os, while lower tract infections are ascending and practically never extend above it.

In computing the averages from many figures in the literature one finds that about 95 per cent of the cases of tuberculosis of the cervix are secondary to active tuberculosis elsewhere in the body, and that approximately 85 per cent of cervical tuberculosis is secondary to upper genital tract infection. Thus about 10 per cent of the cases of this cervical infection are secondary to tuberculosis of the gastrointestinal, pulmonary, or skeletal systems, the bacilli being presumably blood-borne from these foci to the cervix. We also find that the Fallopian tubes are infected in about 90 per cent of all genital tract tuberculosis, the endometrium in about 75 per cent, the ovaries (usually on the surface) in 30 per cent, the cervix in 5 to 6 per cent, and the vagina and vulva in 0.5 per cent.

The pathologic process in the cervix may be superficial, but more often it is deep, and it spreads along the course of the blood vessels apparently by way of the lymphatics (see Figs. 1 to 4). The cervical

glands show hyperplasia and hypersecretion, and are rarely engulfed by the process. Spread from the cervix is said to be by direct extension,¹⁹ the vaginal fornices being first affected, the endometrium next, and shortly thereafter the broad ligaments. The spread from the cervix seems to be slow, and in the author's "primary" case it had not taken place six months after the apparent onset of symptoms. There is no evidence which conclusively shows that remote metastasis ever takes place from cervical tuberculosis. The process in the cervix takes four general forms. The *papillary or vegetative* and the *ulcerative* types are the two most commonly seen, and derive their names from the gross appearance of the cervix. The *interstitial* type is more rare and the infection is deep-seated from the first, apparently being blood-borne from a bodily focus. The *endocervical or catarrhal* type is the earliest form and can be diagnosed only by biopsy as the cervix may show only slight peri-oral erosion or eversion.

Cervical tuberculosis is most frequently mistaken for carcinoma. This fact may account for some of the so-called cancer cures following amputation of the cervix where there was a vegetative growth present and no microscopic examination was made. It is next most often mistaken for the various venereal ulcers and papillary growths, and may be confused with localized gland hyperplasias, traumatic lesions, erosions, mucous polypi, sarcoma, actinomycosis, and simple hypertrophy.⁴⁶ An absolutely positive diagnosis is made only with a biopsy in which the stained bacilli can be demonstrated. In an early case a fragment of excised tissue carefully ground up in a small amount of normal saline and injected into a guinea pig may give a positive diagnosis (if the stained guinea pig gland smear shows the bacilli) where microscopic studies have failed to do so.

The disease occurs most frequently in the 20 to 40 year age group, and its racial predilection is for the American negress. The symptoms are persistent offensive leucorrhea, slight postcoital bleeding, dull pelvilinear pain, and the menses may be or have been normal-to-profuse or scanty-to-absent, generally indicating fresh uterine involvement or general systemic and extensive genital tract involvement, respectively. It is interesting to note that the first three symptoms listed above are the cardinal ones of cervical carcinoma as well, and would naturally lead the examiner to suspect it before tuberculosis. Physical examination reveals a bulky, firm, slightly friable, often non-tender, fairly easily bleeding cervix. It usually shows the papillary or ulcerative forms, and, if advanced, there may be vaginal fornical induration. Some differential diagnostic points which might help to distinguish it from carcinoma are that it is usually more injected, less friable, of more even and moderately firm consistency and the hypertrophy is almost always more symmetrical.

Beyea, Murphy, Moore, Brook, Spalding, Harris, Bishop, and Neu all agree that the treatment should be surgical when possible and as radical as the condition of the patient will allow. Involvement of the bladder or rectum, marked genital tract tuberculosis with involvement of adjacent tissues, active tuberculosis elsewhere

in the body, and the usual heart and pulmonary diseases are contraindications to operation. Cauterization alone is insufficient and inadvisable as it may spread the infection.^{35, 36} Ultraviolet light and general sanatorium regime have helped inoperable cases, and may build them up to a point where operation is possible. Many cases of secondary and a few "primary" tuberculous infections of the cervix have had apparent complete cure following panhysterectomy and bilateral salpingectomy, with removal of ovaries where indicated. This is the operation of choice as soon as the biopsy diagnosis is made.

* * * * *

Eighteen cases of tuberculosis of the cervix (Gyn. Path. 546, 714, 1847, 2792, 12632, 13607, 14666, 20640, 20840, 23238, 24197, 29471, 30623, 34106, 34554, 35997, 41446, and 44043)* have accumulated in the Gynecological Pathology Laboratory of the Johns Hopkins Hospital during the forty-seven years of its existence. Of these cases 13, or 72 per cent, were in negro women, and the average age at which the infection was discovered was 23.2 years. All of the women had complained of leucorrhea, 11 had had postcoital bleeding, 13 had had amenorrhea, and 3 had had metrorrhagia. A history of personal or familial tuberculosis was obtained in 8 of the cases, while 6 of the patients had shown some clinical evidence, quiescent or active, of pulmonary tuberculosis. The treatment in 14 of the cases consisted of panhysterectomy and bilateral salpingo-oophorectomy, and roughly 3 out of 4 are alive and apparently well. One of the cases had advanced pangenital tuberculosis when first seen and was given ultraviolet light treatments and put on a sanatorium regime. She is alive and fairly well despite the fact that her pelvic organs are solidly fixed and she has chronic constipation. The other 3 patients were practically moribund when seen and only a cervical biopsy was taken. Autopsy studies on two of these showed the presence of advanced genital and pelvic tuberculosis. From the 17 patients in whom it was possible to obtain operative and autopsy specimens tuberculous salpingitis was found to have an incidence of 87 per cent.† Tuberculosis was found in the endometrium in 84 per cent of the cases, in the ovaries in 39 per cent, and in the myometrium in 22 per cent. In one case the cervix contained the only tuberculosis found in the genital tract.

The microscopic picture was essentially the same in every case. There was usually some degree of superficial glandular hyperplasia with a few tubercles in the mucosal stroma. The stroma was always relatively densely infiltrated with lymphocytes (see Fig. 1), and in some cases germinal nests of these cells were found. The more easily recognizable were the larger tubercles which, with their giant cells, were situated deep in the body of the cervix and in practically every instance lay near an artery and snugly up against a lymph vessel (see Figs. 2 and 4). One tubercle in Fig. 4 appears as though it opens into the adjacent lymph channel. The presence of these large tubercles

*One of these cases has been reported,¹⁴ and seven were mentioned.²¹

†In some cases where the endometrium was biopsied the tubes were not removed because the patient refused to have a laparotomy. Thus the figure for the incidence of tuberculous salpingitis is probably low.

deep in the body of the cervix and their nearly constant perilymphatic locations are the two most striking findings in the histologic picture of the disease.

* * * * *

The following is the report of a case in which the cervical tuberculosis was apparently the only active lesion in the patient and definitely the only one in the genital tract.

A. C. (Unit No. 74028), a 24-year-old married negress and the mother of two children, first came to the Gynecological Dispensary of the Johns Hopkins Hospital on Sept. 28, 1936. Her chief complaint was lower abdominal cramplike pain for two or three days following apparent cessation of her menstrual periods. This began six months before she was seen, became progressively more severe, and the last attack (September 19 to 21) brought her to the hospital. She had had pain since the end of her last period, but it was relieved when she bled profusely the



Fig. 1.—(Gyn. Path. 44043.) The original cervical biopsy. Note the proliferation of the glands into localized gland nests, the dense lymphocytic infiltration of the stroma, the giant cell with coronal arrangement of the nuclei (A), and the eroded surface epithelium (B). (This tissue was taken from the everted granulation tissue around the os.) ($\times 70$.)

night before she was seen. She had had a moderate leucorrhea for five years, but it had been more profuse following the birth of her youngest child two years before coming to the hospital. For the last four months this discharge had been watery and foul. She had had burning on urination for the two weeks prior to coming to the hospital. None of her family had had recognized tuberculosis. Her general health had been good although she had always been thin and underweight. She had had two full-term normal spontaneous deliveries. A biopsy of the cervix showed some tuberculosis (Fig. 1), and she was admitted to the hospital.

Physical examination showed the following: temperature 99.6° F., pulse 80, respirations 20, blood pressure 140/80, hemoglobin 86 per cent, leucocyte count 15,500, weight 92 pounds; the white blood cell differential count was normal, a catheterized specimen of urine was negative chemically and microscopically, and the blood Wassermann test was negative. She was definitely undernourished. The superficial glands and breasts were negative. The heart and lungs were normal to percussion and auscultation but a chest x-ray showed very slight thickening of the

pleura at the right costophrenic angle. The abdomen was thin-walled, scaphoid, and negative. The pelvic examination disclosed negative Bartholinian glands, a parous outlet, and there was a profuse mucopurulent white discharge of thinner consistency than normal. The cervix was about three times normal size, of relatively normal contour, and of an even but firm consistency. It was freely movable, nontender, and there were superficial lateral lacerations which were made prominent by the marked eversion and hypertrophy of the anterior and posterior lips. The everted portions were injected and granular but not very friable, and the examination caused only slight bleeding from them (see Fig. 5). The external os appeared to be firmly closed by the redundant lips and was marked by a slight horizontal linear

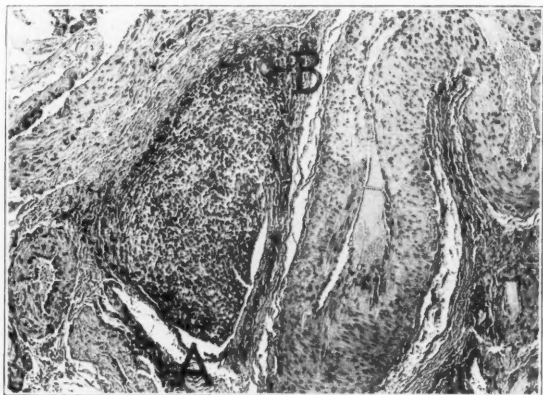


Fig. 2.—(Gyn. Path. 44112.) A large tubercle situated between several blood vessels deep in the body of the cervix. The tubercle apparently lies in the wall of a lymph vessel (A). Note the giant cell at the edge of the tubercle (B). (x70.)

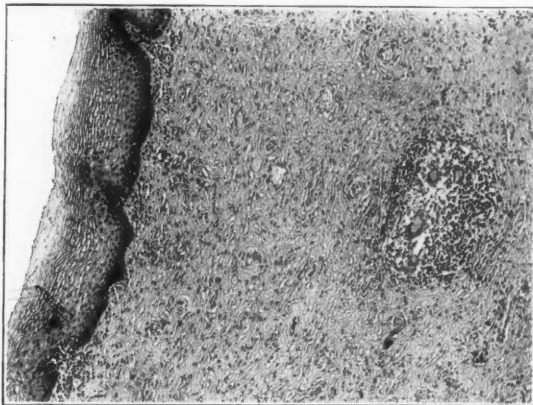


Fig. 3.—(Gyn. Path. 44112.) A section through the portio of the anterior lip. The stratified squamous epithelium is intact and the stroma immediately beneath it shows only a physiologically normal amount of lymphocytes. Note the tubercle with giant cells situated in otherwise normal stroma a short distance beneath the surface. (x60.)

indentation. There was no induration of the vaginal vault or the parametrium. The uterus was normal in size, shape, consistency, and motility, and was in mid-to anterior position. There were no pelvic masses or tenderness, and the ovaries were small and free. The rectal examination was negative and confirmed the pelvic examination. There were no other positive findings.

A panhysterectomy and bilateral salpingectomy were done. The ovaries were normal in appearance and were entirely free from adhesions so they were not removed. She withstood the operation well, the lower abdominal incision healed per

primum, and her postoperative course was remarkably uneventful. She was discharged fifteen days after operation. Since then she has felt well, has developed a good appetite, and when seen in June, 1937 had gained 7 pounds. Repeated chest studies have revealed nothing more than was originally found. The following report on her chest plates was made by Dr. John W. Pierson: "Roentgenological studies of the chest show no active tuberculosis. There has been tuberculous infection in the past but no more than is found in a large percentage of Baltimore negroes."

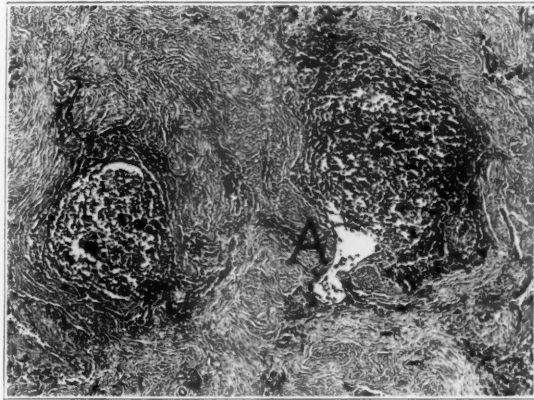


Fig. 4.—(Gyn. Path. 44112.) A section from deep in the body of the cervix. One of the tubercles half surrounds a lymphatic, and looks as though it has ruptured into it (A). ($\times 70$.)

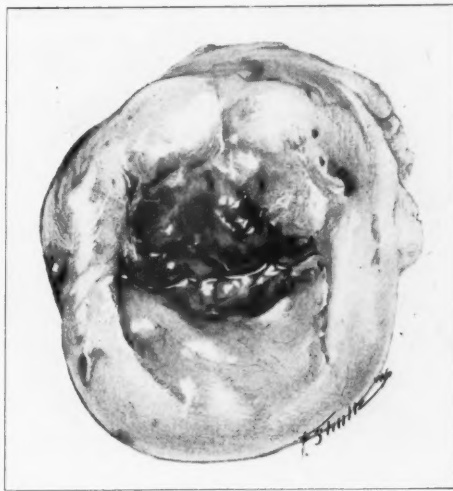


Fig. 5.—Appearance of cervix when first seen. Drawing slightly less than actual size.

The gross pathologic examination of the operative specimen showed the hypertrophied cervix, as described above, the external os of which would admit only a small probe. After fixing in formalin, which causes slight shrinkage, the cervix measured 5 cm. in diameter. The portio was intact save for a border of erosion and ulceration 1 cm. wide around the external os. The consistency was firm, being that of dense fibrous tissue, and on section there was slight injection of the stroma beneath the ulcerated portion of the portio. The surfaces of the uterus and tubes were smooth and shiny, and these organs were grossly normal in every respect.

Microscopic examination of the cervix (Gyn. Path. No. 44043, No. 44112) revealed a picture essentially similar to that general one described above in the paragraph just preceding this case report. The histopathology of the tuberculosis in this cervix is essentially pictured in Figs. 1 to 4.

The cervical canal was lined with a shallow layer of mucosa in which, although the glands were normal, the stroma was densely infiltrated with lymphocytes. A careful search disclosed no tubercles in the canal. Many sections through the uterus disclosed normal myometrium, and the endometrium was slightly infiltrated with lymphocytes and showed a normal nonsecretory interval phase. Half a dozen sections from each tube showed small lumina, delicate and discrete mucosal folds, no inflammatory cells, and a normal thin serosa. Acid-fast stains on all sections from the cervix showed no tubercle bacilli after careful search. The pathologic diagnosis was tuberculous cervicitis; interval endometrium, nonsecretory; normal myometrium; normal Fallopian tube bilateral.

The exact significance of the presence of the large tubercles deep in the cervix in this case cannot be ascertained, but, in view of the apparent absence of any other genital or extragenital active tuberculous focus one might surmise that the infection has penetrated deeply from a superficial mucosal implantation. In addition, the nearly constant perilymphatic location of the tubercles in this case implies that the infection possibly spreads by way of the lymph channels.

It should be remembered that Langhans' giant cells and tubercle-like structures are also found in Boeck's sarcoid,²⁹ in the lesions caused by *B. melitensis*, and in some of the organs removed routinely at autopsy where syphilis was the only known disease before death.

* * * * *

In a few cases, when the patient showed no evidence of tuberculosis outside of the cervix, the exogenous etiology has been demonstrated by the finding of genital tract tuberculosis in a marital partner. As a result of thorough chest and genitourinary studies on the husband of the author's case, no tuberculosis could be found. However there is no guarantee as to the absolute fidelity of the wife, and other partners undoubtedly exist despite her denials.

For those who desire recourse to recently reported "primary" cases the author recommends those of Douglass and Ridlon,¹⁸ White,⁴⁸ Harris,²⁴ Missett,³² and Dannreuther,¹⁵ and for more complete bibliographies and studies of the subject the articles of Bonnet and Bulliard⁷ and Finlayson,¹⁹ and the monographs of Norris³⁶ and Jameson.²⁶

* * * * *

SUMMARY

1. Eighteen cases of tuberculous cervicitis are reported, one of which is the sole tuberculous focus of infection in the genital tract, and the only active one in the patient.

2. Tuberculous cervicitis is of chief interest because it clinically resembles cervical carcinoma and announces the presence of genital tuberculosis.

3. The cervix is involved in from 5 to 8 per cent of the cases of genital tract tuberculosis and thus appears to have a relative immunity to this infection. About 90 per cent of the cases of cervical

tuberculosis are secondary to upper genital tract infection. A true primary cervical tuberculosis is extremely rare.

4. The two chief symptoms are a persistent offensive watery leucorrhea, and bleeding following coitus or douching.

5. Physically the cervix shows symmetrical hypertrophy and superficial friability and the portio may show abnormalities ranging from erosion and eversion to ulceration or papillary granulations.

6. The treatment should be surgical when possible and as radical as necessary and as the condition of the patient will allow.

7. The microscopic pathology is treated in detail and is chiefly characterized by large tubercles lying snugly up against lymphatic channels deep in the body of the cervix and Langhans' giant cells and tubercles scattered through hyperplastic canal mucosa.

8. The term "primary tuberculous cervicitis" demands that it be the only tuberculous lesion in the patient.

The author wishes to thank Dr. Thomas S. Cullen and Dr. Arnold Rich for their help and advice in the preparation of this paper.

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THE QUANTITATIVE DETERMINATION OF ESTROGENIC SUBSTANCES IN NORMAL FEMALE URINE THROUGH THE INCEPTION OF A PREGNANCY*

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IN A PREVIOUS paper¹ we have reported the results of quantitative determinations of estrogenic substances in normal female urines during the menstrual cycle, with details of extraction, the injection of the extracts and the biologic assay. These determinations were done on successive twenty-four-hour specimens of urine, which were collected in some instances to include one complete cycle, and in others more than one, a few consecutive and a few not.

The graphs obtained showed two principal peaks during the cycle, the first of which we believe to represent the height of follicle activity just before rupture, and the second the height of corpus luteum development and activity. The second peak is always followed in normal cases by a rather rapid drop to zero, which in turn is followed in varying short periods of time by menstruation.

The graph shown here (Chart 1) was obtained in the course of an estrin excretion study of a normal individual in whom pregnancy occurred during the time comprised by the study. She was 18 years of age. General and gynecologic examinations were entirely negative. There had been one pregnancy two years before, which had been normal, with normal delivery and puerperium. The menstrual history had always been normal, with approximate twenty-eight-day intervals.

As shown in the graph, urine specimens were obtained beginning ten days before a menstrual period. They were collected daily through the ensuing menstruation and continued through the following interval. The next expected menstrual period did not occur. Specimens were collected for a few days more and discontinued. The date of the last menstrual period was Feb. 4, 1936, and she was delivered by one of us (L.W.M.) on Nov. 10, 1936. The entire course of the pregnancy was normal.

Preceding the last menstruation, there is a peak of estrin excretion at *CL*, followed by a rapid fall and menstruation twenty-four hours later. This premenstrual curve is characteristic of all those we have obtained on normal individuals. Following menstruation there are several relatively slight rises in estrin excretion, with disappearance on one or more days, the significance of which we do not know. We have found this in a number of other cases.

The first appreciable peak reached in the curves obtained in all of our other cases is in the relative position of the one marked *O* on Chart 1. As stated above and previously, we believe this to represent the height of follicle activity just prior to rupture. As can be seen by referring to our previous paper, they have all been considerably higher than in this case. Otherwise the pictures are fundamentally the same.

*This investigation was aided in part, by a grant from the National Research Council, Committee on Problems of Sex.

As in all other cases, this peak is followed by a fall, in this case to zero (in several other cases to zero, in others not), and the curve in turn rapidly rises to the second peak *CP*, which is in the present instance identical in I.R.U.E. (International rat unit equivalents) with the premenstrual peak *CL* in the previous cycle. This peak we believe represents the height of corpus luteum activity.

As can be seen, there is the usual beginning premenstrual drop, but only to about 480 I.R.U.E., whereupon there is a rapid intermittent rise. This is in line with what we know about the persistence of the corpus luteum of pregnancy. It seems certain that conception occurred somewhere between *O* and *CP*. We believe that the halt to the estrin fall, following the peak *CP*, probably represents nidation of the fertilized ovum, and that the increase in estrin output may either be caused by some stimulus to the corpus luteum by this phenomenon, or it may be directly referable to the very young trophoblast itself. Since we believe that later the entire hormone function is taken over by the placenta, the latter view seems entirely possible.

It is of interest to note that the peak *CL* occurred five days previous to the last menstrual period, and that the peak *CP* also occurred just five days preceding what

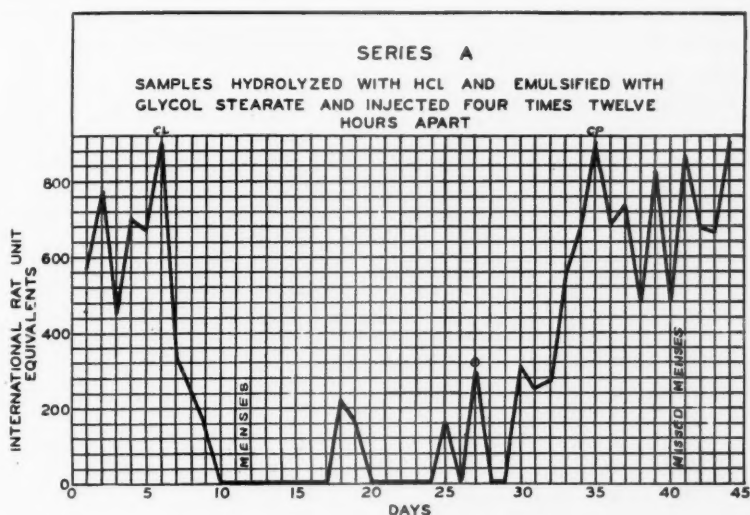


Chart 1.

would have been the next menstrual period in the twenty-eight-day cycle, had it occurred. As stated in our previous paper, however, this equality of time relationships between the estrin peaks and menstruation, or of the peaks to each other, does not necessarily obtain, even in succeeding cycles in the same individual.

Smith and Smith² have reported estrin studies in two cases which covered the periods of ovulation, conception and early gestation. Their studies and ours are fundamentally alike, both for the regular menstrual cycles and during the inception of pregnancy. They differ, however, in that we have consistently found a peak which we believe to represent the height of follicle development before rupture, and also in that we have not found the constant relationship between the corpus luteum peaks and the subsequent menstrual periods. Their extractions were done on twenty-four-hour specimens obtained twice a week or oftener. Koch and his associates³ have made similar studies of normal menstrual cycles and have found a suggestion of two peaks during the cycle.

We are of the opinion that only the analysis of daily specimens gives a true picture of urinary excretion of estrin, since we have found as

much as 700 or more international rat unit equivalents in one twenty-four-hour specimen, while the specimen for the preceding twenty-four hours, and the one for the following twenty-four hours, contained none. It is evident that were the specimens obtained even three times a week, if none were examined for that particular twenty-four hours, one might erroneously conclude that there had been no estrin excretion in the interim.

It is to be hoped that an increasing number of similar graphs can be accumulated for study, but it can be appreciated that to secure one will always be pretty much of a fortunate accidental occurrence. The values of such graphs, particularly in sterility studies, and in connection with the subject of contraception, is evident.

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HYSTERECTOMY

A TEN AND A HALF YEARS' STUDY

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WE HAVE made a study of all the hysterectomies performed in Multnomah Hospital in a period of ten and a half years, from July, 1925 to January, 1937. During that time 779 hysterectomies were performed. There were 20 deaths, an incidence of 2.56 per cent. Each case in this survey was carefully considered from the standpoint of age, complaints, preoperative diagnosis, type of hysterectomy, complications, operative and postoperative progress, pathologic findings, and mortality.

PREOPERATIVE CONSIDERATION OF PATIENTS

We have tabulated only the five principal complaints (Table I). There were, of course, many others. It will be noted that almost all of the patients complained of pain and discomfort, over half complained of abnormal vaginal bleeding, and fully one-fourth complained of urinary disturbances of some kind or other. A number of tumors were found in routine examination.

There were 17 patients in the group of ages up to and including 19 years, and 111 in the group from 20 to 30 years. Ninety-six patients were between 50 and 60 years old, and 43 were 60 years and over. The ages of the remaining 512 patients (65.72 per cent) ranged from 30 to and including 50 years.

The preoperative diagnoses (Table II) can be covered almost entirely by three conditions; namely, tumors, uterine prolapse with its accompanying cystocele and rectocele, and pelvic inflammatory disease. Tumors alone accounted for practically three-fourths of the preoperative diagnoses, while 185 patients suffered from the sequelae of pelvic inflammatory disease.

TABLE I. FIVE PRINCIPAL COMPLAINTS

COMPLAINT	NUMBER	PER CENT
Pain and discomfort	705	90.50
Abnormal vaginal bleeding	475	60.97
Urinary disturbances	183	23.49
Tumors	155	19.89
Leucorrhea	125	16.04

There were, of course, many other complaints. These are the chief complaints as registered on the records.

TABLE II. PREOPERATIVE DIAGNOSIS

DIAGNOSIS	NUMBER
Fibromyoma	339
Relaxed perineum (including cystocele, rectocele, and urethrocele)	241
Pelvic inflammatory disease	185
Prolapse (with cystocele and rectocele)	122
Lacerated cervix (4 with polyps)	97
Ovarian cysts	91
Fibrosis uteri	42
Carcinoma of fundus (1 chorioepithelioma)	27
Retroversion	10
Ectopic pregnancy	10
Carcinoma of cervix	9

OPERATIVE PROCEDURES

The hysterectomies in this series were of the total, subtotal, and vaginal types, with a preponderance of the subtotal (Table III). The vast majority of the patients had additional operative procedures at the time the hysterectomy was performed

TABLE III. TYPE OF HYSTERECTOMY AND MORTALITY

TYPE	NUMBER	DEATHS	PER CENT
1. Subtotal	572	11	1.92
2. Total	79	6	7.59
3. Vaginal	128	3	2.34
Totals	779	20	2.56

TABLE IV. ADDITIONAL PROCEDURES

PROCEDURE	NUMBER
Oophorectomy (219 unilateral, 220 bilateral)	439
Salpingectomy (101 unilateral, 315 bilateral)	416
Perineorrhaphy	223
Appendectomy	152
Diagnostic curettage (12 with biopsy)	86
Anterior colporrhaphy	21
Cautery of cervix	19
Ovarian transplantation	17
Radium	14
X-ray	13
Trachelorrhaphy	13
Herniorrhaphy	6
Miscellaneous	18

The discrepancy between the number of oophorectomies and the number of salpingectomies is explainable by the fact that some of the patients had had their tubes removed at a former operation.

(Table IV). Salpingectomy and oophorectomy were performed on more than half of the patients. Many of the hysterectomies, where it seemed expedient, were done in conjunction with bilateral salpingectomy and other surgical procedures.

OPERATIVE AND POSTOPERATIVE PROGRESS

In eight instances the operation was complicated by hemorrhage. Three of the hemorrhages formed hematomas in the broad ligament, and one was the result of rupture at the internal os with a Hegar dilator. In two instances there was an injury to the bladder followed by a vesicovaginal fistula, but in no instance was there an injury to the ureters. Primary shock occurred in six patients. One patient had diabetes, and one had heart disease.

One hundred and fifty-seven patients (20.15 per cent) had postoperative complications of various kinds (Table V). The heading "other complications" in the table includes (one case of each) nephritis with uremia and subsequent death, infected hematoma of the pelvis, hypertension with cardiovascular renal disease and fibrillation, pulmonary infarct, thrombosis of the femoral vein, and unexplained

TABLE V. POSTOPERATIVE COMPLICATIONS

COMPLICATION	NUMBER
Infected incision	43
Cystitis	17
Pelvic abscess	16
Pyelitis	14
Pneumonia	13
Ileus (1 obstruction)	11
Hemorrhage	10
Peritonitis	10
Hernia	7
Fistula (3 abdominal, 2 vesicovaginal, 1 rectovaginal)	6
Evisceration	2
Hematoma	2
Damage to ureters	0
Other complications	6

TABLE VI. MALIGNANCIES FROM PATHOLOGIC REPORTS*

SITE	CASES	TYPE OF MALIGNANCY	OTHER LESIONS
Fundus	23	13 Adenocarcinomas	1 Adenomyoma
			1 Cervicitis
			1 Chronic salpingo-oophoritis
		3 Papillary adenocarcinomas	1 Myoma and pyosalpinx
			1 Fibromyoma
Cervix	6	3 Squamous cell carcinomas	None
		3 Carcinomas (unclassified)	1 Chronic salpingitis
		1 Chorionepithelioma	None
		2 Squamous cell carcinomas	1 Myoma and chocolate cyst
		4 Carcinomas (unclassified)	1 Hydrosalpinx, cystadenoma of ovary
Ovary	8	1 Adenocarcinoma	Peritoneal implantation
		4 Papillary adenocarcinomas	1 Leiomyoma
		1 Primary carcinoma	Fibromyoma and chronic sal- pingitis
		1 Malignant serous cystadenoma	Myoma uteri
		1 Malignant cystoma papilliferans	None
Tube	1	1 Carcinoma (unclassified)	None
Sigmoid	1	1 Adenocarcinoma	Myoma uteri

*Of late practically all patients with carcinoma of the cervix have been treated with radium.

twenty-six days' fever. The average number of febrile days was 4.7, and the average time spent in the hospital was fifteen days.

Dermoids of the ovaries were found in four patients. In one instance the dermoid occurred with an adenomyoma and a parovarian cystoma. Thirty-nine patients had malignancies of one kind or another (Table VI). More than half of these (58.97 per cent) were in the fundus of the uterus. It is interesting to note that in 13 instances

TABLE VII. SURGEONS, OPERATIONS, MORTALITIES

SURGEON*	HYSTERECTOMIES	DEATHS	PER CENT
A	212	3	1.41
A	209	5	2.39
A	99	4	4.04
A	73	3	4.11
A	60	3	5.00
R	49	1	2.04
14 others (R-V)	77	1	1.29
Totals 20	779	20	2.56

*A, Attending gynecologist. R, Resident gynecologist. V, Visiting surgeon.

TABLE VIII. HYSTERECTOMY MORTALITY (VARIOUS HOSPITALS)

HOSPITALS	YEARS	HYSTERECTOMIES								
		SUBTOTAL ABDOMINAL			TOTAL ABDOMINAL			VAGINAL		
		NO. OF CASES	NO. OF DEATHS	PER CENT	NO. OF CASES	NO. OF DEATHS	PER CENT	NO. OF CASES	NO. OF DEATHS	PER CENT
Lane Hospital, San Francisco ¹	10	265	8	3.0	307	10	3.2	73	0	0
San Francisco Hospital ¹	10	408	12	2.9	196	8	4.0	28	4	14.3
University Hospitals, Iowa City ²	7½	274	10	3.6	314	17	5.4	151	3	2.0
Lakeside Hospital, Cleveland ³	13	609	27	4.4	1,078	45	4.1	164	6	3.6
Lakeside Hospital, Cleveland ⁴	5	653	16	2.3	821	22	2.6	70	3	2.9
Mayo Clinic, Rochester ⁵	3	487	9	1.9	1,118	15	1.3	333	7	2.1
Harper Hospital, Detroit ⁶	5	1,141	30	2.6	235	15	6.4	-	-	-
Presbyterian Hospital, Chicago ⁷	-	-	-	-	-	-	-	627	3	0.47
Free Hospital for Women, Brookline ⁸	26	1,900	34	1.7	-	-	-	-	-	-
University of California Hospital, San Francisco ⁹	9½	514	4	0.77	163	1	0.61	70	1	1.4
Cook County Hospital, Chicago ¹⁰	5	1,408	65	4.6	551	26	4.7	158	3	1.9
Multnomah Hospital, Portland	10½	572	11	1.92	79	6	7.59	128	3	2.34
Totals		8,231	226	2.74	4,862	165	3.39	1,802	33	1.83

In the Los Angeles County Hospital¹ the types of hysterectomy were not tabulated. In a period of 6 years 2,352 hysterectomies were performed with 83 deaths, a mortality of 3.5 per cent.

In the Cook County Hospital¹² during a period of ten years 3,129 supra-vaginal hysterectomies were performed for myomas of the uterus. There were 78 deaths, an incidence of 2.1 per cent.

other pathologic conditions existed simultaneously with the malignancies. Three hundred and forty-four patients had fibroid tumors. In only 8 instances (2.32 per cent) was the fibroid associated with malignancy; this association was purely coincidental.

In this series of 779 hysterectomies there were 20 deaths, a mortality of 2.56 per cent. The deaths, considered from the standpoint of individual surgeons, are listed in Table VII. In studying this table, one cannot fail to be impressed by the fact that the mortality rate was constantly in inverse ratio to the number of patients operated upon—the greater the number of operations, the lower the percentage of deaths. Most of the operations were done by attending gynecologists and residents on the gynecologic service. Five attending gynecologists did 653 operations with 18 deaths, and 8 resident gynecologists did 126 operations with 2 deaths, a mortality of 2.75 and 1.58 per cent respectively. The operations by the residents were done on selected patients and under the supervision of an attending gynecologist.

We have also made a study of the statistics of hospitals in which a large number of consecutive hysterectomies were done (Table VIII), and found that the mortality for the three types—subtotal, total, and vaginal—ranged from 0.47 to 14.3 per cent, with an average for each type of 2.74, 3.39, and 1.83 per cent, respectively. We found further that while the same procedure was not favored in all the hospitals, the number of subtotal hysterectomies done far exceeded that of either the total or vaginal types.

The causes of the deaths in our series of cases are given in Table IX. It will be seen that peritonitis was responsible for almost half of them.

TABLE IX. CAUSES OF DEATH

CAUSE	NUMBER
Peritonitis	8
Pneumonia	3
Embolism	3
Shock	3
Hemorrhage	1
Uremia	1
Generalized carcinomatosis	1
Total	20

Because Greenhill's mortality¹⁰⁻¹¹ was eleven times as high when both adnexa were removed as when a simple supracervical hysterectomy was done, we studied our cases with this point in mind. Table X shows our percentages with all types of operation. We can offer no explanation for the difference between Greenhill's figures and ours.

TABLE X. MORTALITY WITH RELATION TO ADNEXAL REMOVAL

OPERATION	NO.	DEATHS	PER CENT
Supravaginal hysterectomy			
Without adnexal removal	181	3	1.65
With partial salpingo-oophorectomy*	227	4	1.76
With bilateral salpingo-oophorectomy	164	4	2.43
Total hysterectomy			
Without adnexal removal	21	2	9.52
With partial salpingo-oophorectomy*	18	1	5.55
With bilateral salpingo-oophorectomy	40	3	7.50
Vaginal hysterectomy	128	3	2.34
Totals	779	20	2.56

*Partial salpingo-oophorectomy as used here indicates all combinations of adnexal removal except bilateral salpingo-oophorectomy.

We feel that we have reduced our mortality by a strict observance of the sedation rate. This observance has stood us in fine stead as a criterion for operation on patients with salpingitis. We have avoided operation whenever possible

as long as the sedimentation rate remained high. During the last few years we have also avoided doing a hysterectomy on any patient who had had the cervix cauterized a short time before. One death, we found, was caused by an embolus cast off from a thrombus in a vessel in a cauterized area.

More thorough study of each patient, a better selection of the type of operation, more frequent use of blood transfusions, and more experienced surgeons are the important factors in the reduction of the mortality of hysterectomy.

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A COMPARATIVE STUDY OF THE CLASSICAL AND CERVICAL CESAREAN SECTIONS AT THE BROOKLYN HOSPITAL IN A SERIES OF 164 CASES*

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THIS study was suggested when I recently read an article by Frank W. Lynch¹ who had made a comprehensive survey of cesarean sections throughout the United States. He makes the following comment: "It appears as if this operation (meaning the low cervical cesarean section) was almost unknown or not acceptable to the vast majority of physicians who are performing cesarean sections, because, from 60 to 80 per cent of all cesarean sections in the mortality studies were of the classical type."

It is generally accepted by most obstetricians that a low cervical section rather than a classical operation is the procedure of choice when there is any question of infection present. However, there are many who do not feel that the low section should take preference over the classical operation in elective cases.

This paper presents a comparative review of the low and classical cesareans done at the Brooklyn Hospital during the past ten years and certain views which seem to me sufficient reason to advocate the low section in practically all cases. Among the exceptions might be included cases which present mechanical difficulties such as fibroma on the anterior surface of the lower uterine segment, dense adhesions in this region and, possibly those cases where the length of operating time is a factor, especially if the operator is not thoroughly familiar with this type of operation. It is obvious that a comparison should be made, not only of the immediate, but also of the remote results, of both opera-

*Read at a meeting of the Brooklyn Gynecological Society, April 1, 1938.

tions. Ideally to judge the advantages of one type of operation over the other, a comparison should be made of a large series of cases preferably done in the same hospital where the same operative technique and post-operative care are followed.

While there is evidence that the classical operation continues to be the operation of choice by some in elective sections, it is quite certain that the low cervical section is almost invariably done when there is any question of infection. It is generally felt that the immediate outcome, namely the morbidity and mortality, is definitely lowered by the low operation. Also, we must consider the more remote possibilities, such as a high suspension or fixation of the uterus, the development of adhesions predisposing to intestinal obstruction and the dangerous chance of a rupture of the uterus in a subsequent pregnancy. These all must be taken into consideration when making a decision as to which type of operation should be done, for probably all of the immediate and remote complications are less with a low section.

At the Brooklyn Hospital, covering a period of ten years from 1927 to 1936 inclusive, there were 10,101 deliveries at or near term, 164 of which resulted in a cesarean section, an incidence of 1 in 61. There were 113 classical and 51 low cervical sections.

This series may be too small from which to make any significant deductions but it makes another addition to those already reported on this subject.

TABLE I. INDICATIONS FOR SECTION

	CLASSICAL (113 CASES)	LOW CERVICAL (51 CASES)		CLASSICAL (113 CASES)	LOW CERVICAL (51 CASES)
Disproportion	36	20	Miscellaneous:		
Previous section	32	12	Malpresentation and	8	0
Ruptured uteri	3	0	malposition		
Placenta previa	1	1	Fibromas	6	0
Premature separation	1	0	Cervical dystocia	3	5
of placenta			Previous pelvic	3	2
Heart lesions	8	7	plastic operations		
Toxemias:			Previous myomectomy	1	0
Pre-eclampsia	4	2	Patient who had 5	1	1
Eclampsia	1	0	premature labors		
Chronic nephritis	3	1	with stillbirths		
Unclassified	2	0			

It is worth noting that the three sections done for ruptured uteri all occurred in patients who had been previously subjected to classical sections, none in those who had had low cervical sections. Two of these patients had rather prolonged febrile reactions post partum with the original operation, the third patient also had a moderately febrile post-partum course. This experience is in accordance with most observers who agree that infection following a section favors a rupture during a following pregnancy or labor.

Other procedures that were done in conjunction with the sections are as follows: 32 Pomeroy sterilizations, 1 oophorectomy, 2 myomectomies, and a removal of a fibroma of the abdominal wall.

Two accidents occurred during the operative procedures while doing a cervical section, one was an injury to the bladder and the other was uncontrollable bleeding from the veins of one of the broad ligaments which necessitated a hysterectomy. Both of these patients recovered.

Two ventral hernias developed after the classical operations and two following the low cervical operation.

Operations for intestinal obstruction due to bands which were probably the result of previous classical sections were done on two patients, one a year following the section and the other during the next pregnancy.

In Table II a comparison is made of the number of hospital post-operative days, the operating time, and the average morbidity in the two types of operation.

TABLE II

	CLASSICAL (113 CASES)	CERVICAL (51 CASES)
Days in hospital	20 days	20 days
Average postoperative Temperature above 100.4° F. after first 24 hours— average days per case	3.6 days	3.44 days
Operating time	39.5 minutes	49.6 minutes

TABLE III. MORBIDITY

	CLASSICAL (113 CASES)	LOW CERVICAL (51 CASES)
Wound infection	9	2
Pneumonia	3	1
Retained lochia	2	2
Pyelitis	2	0
Ruptured wound	1	0
Thrombophlebitis of veins in leg	3	1
Pulmonary embolism	4	0
Mastitis	1	0
Intestinal obstruction with peritonitis	2	0
Toxic ileus and sepsis	1	0
Acute ileus	1	0
Undetermined	2	3

It is interesting to note that there were 4 cases of pulmonary embolism in the classical group and none in the low section group, and 3 cases of thrombophlebitis of the veins of the leg following the classical section to one in the low section. In this small series thrombosis and emboli were more common in the classical group, and it may be that the location of the incision in the contractile portion of the uterus near the venous sinuses is the explanation. There were 2 cases of intestinal obstruction with peritonitis in the classical group and none in the low group. Here again it would appear that the high location of the wound in a uterus which almost immediately starts contracting and relaxing after it is emptied would not favor primary union. This would in turn favor the passage of lochia into the general peritoneal cavity thus permitting the development of peritonitis, adhesions, and intestinal obstruction.

TABLE IV. MATERNAL MORTALITY

	CLASSICAL SECTION (113 CASES)	LOW CERVICAL SECTION (51 CASES)
Cardiac decompensation	1	0
Toxemia of pregnancy, premature separation of placenta, and suppression of urine	1	0
Toxic ileus	1	0
Sepsis and paralytic ileus	1	0
Pulmonary embolism	2	0
Intestinal obstruction	2	0

There were 8 deaths following the classical operation and none following the low section. The death which resulted from cardiac failure and the one following toxemia of pregnancy complicated by premature separation of the placenta would undoubtedly have occurred regardless of the type of operation. However, it is quite likely in some of the other 6 patients that the outcome would have been different had a low cervical section been done.

FATALITIES

CASE 1.—A. M. (Unit 35995.) A classical section and Pomeroy sterilization under local anesthesia were done on a primipara, aged 20 years, within two weeks of term. The indication was congenital heart disease with symptoms of decompensation. She died of cardiac failure eight hours after the operation.

CASE 2.—J. McG. (Unit 60932.) A classical section was done on a primipara, aged 25, on Aug. 12, 1934; she was 7 weeks premature. The indication was toxemia of pregnancy complicated by concealed hemorrhage due to a premature separation of the placenta. At operation much fluid blood and clots escaped from the uterus under tension. The uterus showed many petechiae and a few larger areas of ecchymosis. The left broad ligament was hemorrhagic. About eighteen hours later she vomited 12 ounces of bloody fluid but was apparently doing well. She developed a suppression of the urine and all treatment directed to this was of no avail.

CASE 3.—A. J. (Unit 43420.) A classical section was done in a primipara, aged 25, at term Feb. 13, 1931. The indication was a contracted pelvis following a twelve-hour test of labor with membranes intact. The patient did poorly after operation, soon developing abdominal distention, vomiting, and a moderately high fever. These symptoms persisted and she died six days postoperatively with a diagnosis of toxic ileus.

CASE 4.—B. H. A classical section and Pomeroy sterilization were done May 18, 1934, on a para v at the onset of labor. The indication was two previous sections. She did poorly soon after the operation, developing a rapid pulse, a high temperature, vomiting, and abdominal distention. A diagnosis of paralytic ileus was made. She died five days postoperatively. At autopsy pus was found in the abdominal wound and in the uterine wound. Several coils of small gut were densely adherent to the abdominal wall. There were some blood clots and free blood in the peritoneal cavity probably due to a ligature slipping over the resected portion of the left Fallopian tube. This hemorrhage only partially accounted for her death, sepsis and paralytic ileus being the actual causes.

CASE 5.—A. N. (Unit 48706.) A classical section for nephritic toxemia two weeks before term was done on a para i, aged 32, two hours following spontaneous rupture of the membranes. Postoperatively, the patient had a moderately febrile reaction every day, but it was thought that she would recover. On the fifteenth day she developed a pulmonary embolism and died fourteen hours later.

CASE 6.—B. S. (Unit 12153.) A classical section was done on a primipara, aged 39, at term Sept. 17, 1927. The indication was poor progress in an elderly patient. Membranes had been ruptured twenty-four hours with fairly active labor for twenty-four hours. Her postoperative course was uneventful and afebrile until the fifth day when she developed symptoms of acute collapse with pain in the right shoulder, cyanosis, and a rapid pulse and a temperature. She died eighteen hours later. Diagnosis: Pulmonary embolism.

CASE 7.—A. D. (Unit 42448.) A classical section was done on a primipara, aged 36, at term on Nov. 30, 1930. The indication was a big baby with a breech presenting in an older patient who made unsatisfactory progress. Rupture of the membranes and active labor had existed seventeen hours. She had a very stormy postoperative course, developing pulmonary collapse and lobar pneumonia. A laparotomy was done twenty-three days following the section for an acute intestinal obstruction due to adhesions. There was considerable exudate in the pelvis. She died two weeks following this and thirty-seven days following the section.

CASE 8.—V. L. (Unit 40843.) An elective classical section was done on a para ii, aged 31, on Aug. 15, 1930, two weeks before term. The indication was a previous section. On the seventh day following operation a diagnosis of complete obstruction was made and at laparotomy the obstruction was found to be due to an adhesion between the small intestine and the parietal peritoneum. The adhesion was released but the patient died twelve hours later. Diagnosis: Intestinal obstruction.

SUMMARY

Cesarean section in this series resulted in a high maternal mortality. This may be due to the relatively large number of classical operations performed. During the past four or five years we have done fewer classicals and more cervical sections, and this has resulted in a definitely lower maternal mortality.

In this group the more serious complications such as ileus, pulmonary embolism, thrombophlebitis of the veins of the leg, peritonitis and intestinal obstruction occurred relatively more frequently following the classical operation.

There were eight deaths all of which followed the classical operation.

Sections were done for 3 ruptured uteri all of which were subsequent to previous classical operations.

Two patients were operated upon for acute intestinal obstruction during the post-partum period because of bands of adhesions. Two other patients developed acute intestinal obstruction due to adhesions some time after discharge from the hospital. All of these occurred after classical sections. It appears that the troublesome adhesions are more likely to develop following the classical operation.

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THE EXPERIMENTAL PRODUCTION OF INTERSEXUALITY IN THE FEMALE RAT*

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PARTIAL or complete sex reversals have been found in almost all classes of animals. In the human being, there are innumerable cases of pseudohermaphrodites reported. About 30 cases of true hermaphrodites, that is, individuals having gonads of both sexes, are considered as authentic.¹ Many theories have been presented in explanation of these abnormalities and much work has been done in attempts to reproduce them in experimental animals. Such procedures have been almost uniformly unsuccessful in mammals. In contradistinction to the mammalian experiments, very striking results have been obtained with amphibia and birds. The developing embryos of these animals are self-sufficient units, and, as such, are capable of being influenced by operative procedures and by environmental changes. The mammalian embryo is so situated that procedures which might conceivably alter its sexual differentiation interfere either directly with its own viability or with the life of its host, the mother.

The classic experiment in the field of mammalian intersexuality is that performed by nature, the production of the "free martin." The free martin is one member of twins in cattle, the other member is a normal male. Genetically a female, the free martin is masculinized to varying degrees. There is an atrophy or lack of development of Müllerian duct derivatives (oviducts, uterus, and upper vagina). The Wolffian duct derivatives (epididymis, vas deferens, seminal vesicles, and ejaculatory ducts) are usually present. The external genitalia (urogenital sinus and genital tubercle derivatives) are usually feminine in appearance and changes in the gonads are usually found. It has been established by Lillie and his co-workers that the free martin is produced only when there is an anastomosis between the placental vascular systems of the embryonic male and female.²⁻⁴ He has theorized that an hormone from the male reaches the female via the interconnecting blood supply. This "male sex hormone" inhibits the Müllerian or female duct derivatives and stimulates the Wolffian or masculine duct derivatives.² Thus a masculinized female or intersexed animal results.

In the early, sexually undifferentiated embryonic state, the Müllerian and Wolffian ducts co-exist, and up to a certain period the embryo is equipotential as to future sexual development. That is, the anlage of both male and female sexual systems is present. Inasmuch as the gonad of the male differentiates into a testicle earlier than the gonad

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of the female differentiates into an ovary, it is possible that the "male hormone" being formed first should have a directive influence on the development of sexual structures in the female twin, inhibiting female structures and stimulating male structures.

Attempts to influence sex development in amphibia and birds by administering sex hormones to the developing embryo have been successful. Partial (intersexes) and complete sex reversals have been obtained by this method in both amphibia and birds.⁵⁻¹⁸ Attempts to influence sexual differentiation of the mammalian embryo by administering sex hormones to the pregnant mother have met with slight success. Evidence has been presented, however, that development of the external genitalia of female rats can be permanently modified by giving large doses of estrogenic substance to the pregnant mother of these animals during the last few days of her pregnancy.¹⁹⁻²³ The lesion produced is a marked hypospadias (the female rat normally has a complete clitorine urethra). While this modification is a permanent arrestment of the caudal portion of the urogenital sinus, it can hardly be considered in the light of an intersexual change. The male has only been slightly affected. The amount of female sex hormone that can be given to the pregnant rat is limited. Large doses, given early enough in pregnancy to conceivably feminize the male embryo, have caused resorption or abortion of the pregnancy in our experimental work to date.

In view, however, of the very definite effect of estrogenic substance on the development of the external genitalia of the rat, it was hoped that male sex hormone might have an analogous action, and might even influence the development of the female embryo sufficiently to produce some evidence of true intersexuality. The rat is a good subject for such an experiment. Its gestation period is short (twenty-two days), and its embryonic development is relatively slow. Implantation takes place on the fifth day,²⁴⁻²⁶ and a placenta like that of the human being, with chorionic cells in direct contact with the maternal blood stream, is developed. The indifferent gonad starts to differentiate into a testis late on the fourteenth day.²⁷ If the gonad is to be an ovary it does not start to differentiate until the seventeenth day.²⁷

EXPERIMENTS AND RESULTS

Pregnant rats have been injected with testosterone and testosterone propionate. Varying doses have been given at different periods of the last third of the pregnancy by single or multiple injections. The pregnancy of the majority of these treated animals has been terminated by resorption or abortion. Of 152 animals treated, 55 have delivered at term, spontaneously or by cesarean section. The female offspring of 45 of these litters have shown varying degrees of masculinization. Apparently subthreshold dosages were responsible for lack of masculinizing changes in the females of the 10 remaining litters. Sixty-four newborn and 40 adult intersexed animals have been studied by gross and microscopic dissections. Histologic specimens and whole mounts have been prepared, and wax plate and graphic reconstructions have been made. The degree of masculinization seems to vary with the amount of male sex hormone given and also with the period of pregnancy when treatment is administered. A difference in response between litters is noticeable, but there are only slight variations between females of the same litter.

Changes in the external genitalia vary. Small dosages inhibit development of the vaginal introitus so that the external vagina is represented by a crescentic skin



Fig. 1.—External genitalia of intersexed Rat 29-A. Animal has no vaginal orifice. Penis is shown everted.

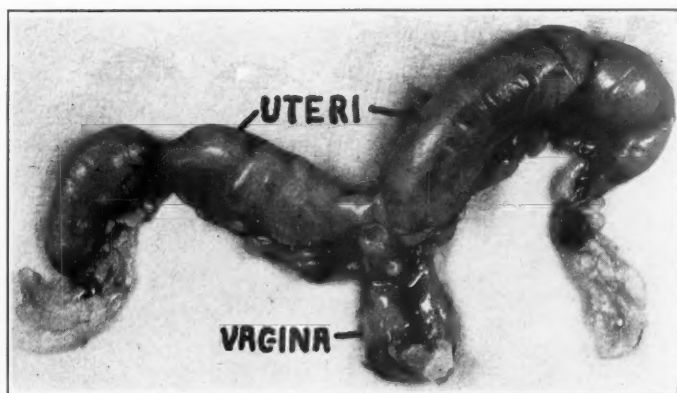


Fig. 2.—Dissected genital tract of intersexed Rat 69-B. Uteri and vagina are greatly distended with retained secretions because no patent vaginourethral communication is present.

fold embracing the caudal base of the phallus which is hypospadiac. Larger doses cause the production of a penis with a nonpatent "skin fold." With still larger dosages, the external vagina is completely absent and the phallus is a small but apparently normal penis (Fig. 1). An os priapi which is present in the normal male rat is also found in the penis of these intersexed animals.

Changes in the internal genitalia are equally striking. The lower part of the vagina is completely absent with the higher dosages. In some animals the upper

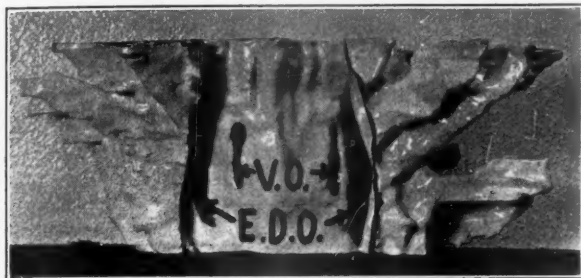


Fig. 3.—Wax plate reconstruction of part of the urogenital region of adult intersexed Rat 29-A. The front of the urethra has been cut away to show the vagina emptying into the urethra by bilateral ostia. V.O., vaginal orifices; E.D.O., ejaculatory duct orifices.

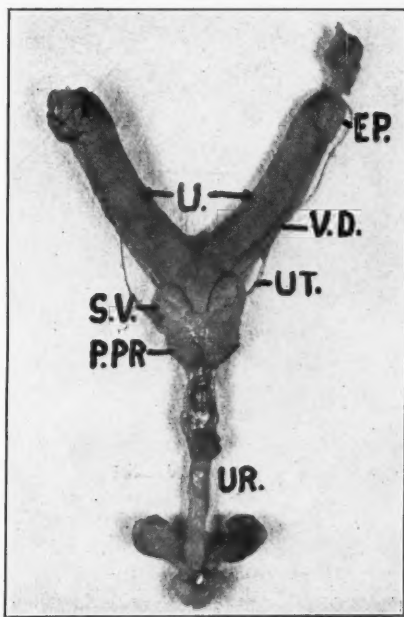


Fig. 4.—Dissection of genital tract of intersexed Rat 80-B. (dorsal view). Left gonad was removed for histologic study. U., uteri; V.D., vas deferens; EP., epididymis; S.V., seminal vesicle; P.PR., posterior prostatic lobe; UR., urethra, UT., ureter.

two-thirds appears to end blindly. In these animals the uteri and upper vagina are markedly distended with retained secretions (Fig. 2).

In other animals whose mothers have received still higher dosages, the vagina communicates with the urethra by bilateral ostia medial to the ostia of the ejaculatory ducts. A wax plate reconstruction of this region has been made from serial sections of one of these adult animals (Fig. 3). This condition is interpreted as a preservation of the original bilateral communications of the Müllerian ducts with the urogen-

ital sinus. Serial sections and wax plate reconstructions reveal similar conditions in the newborn affected animal. In some, the bilateral junctions of the vaginal epithelium with the epithelium of the urethra are not patent, but in others they are patent.

Combined with the agenesis of the distal part of the vagina, there is a development of masculine urogenital sinus derivatives. In well-modified animals all the various prostatic lobes are found. In less well-modified animals fewer lobes are present; in some cases prostatic development is represented by the presence of ventral lobes alone. These lobes (para-urethral glands) have been observed macro-

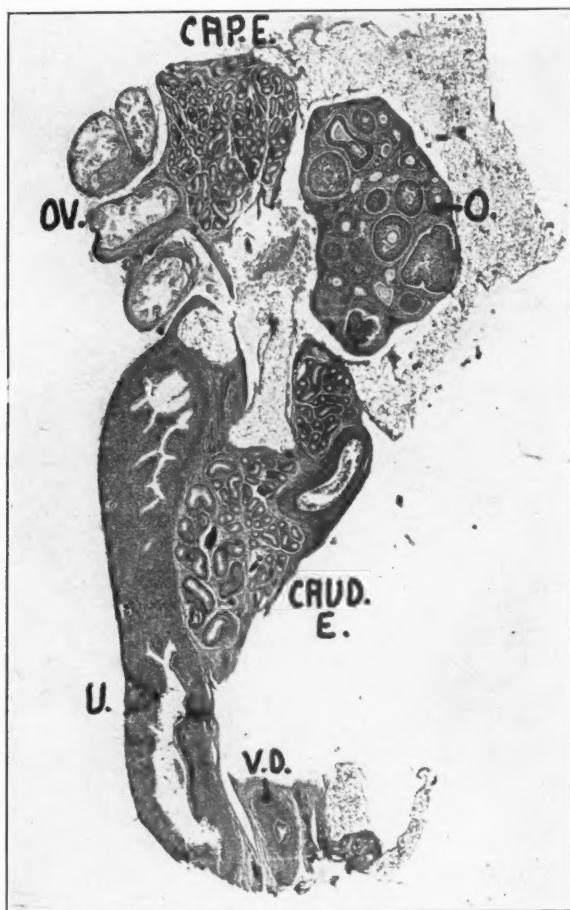


Fig. 5.—Section through left gonad region of young intersexed Rat 80-A. O., ovary; OV., oviduct; U., uterus; V.D., vas deferens; CAP.E., caput epididymis; CAUD.E., caudad epididymis.

scopically in experimental animals having no other internal or external genital abnormality. In the normal adult female they are usually not grossly visible but have been reported as present in the majority of normal females treated with large doses of male sex hormone.^{28, 29}

Complete Wolffian duct derivatives have been found as bilateral structures in 6 adults and as unilateral structures in 2 adults. These derivatives include head and tail of the epididymis, vas deferens, seminal vesicle, and ejaculatory duct (Figs. 4 and 5). Efferent tubules connect the head of the epididymis with the rete of the gonad.

In less well-modified females, only seminal vesicles and ejaculatory ducts are present. The various prostatic lobes have been found with no preservation of the Wolffian duct derivatives.

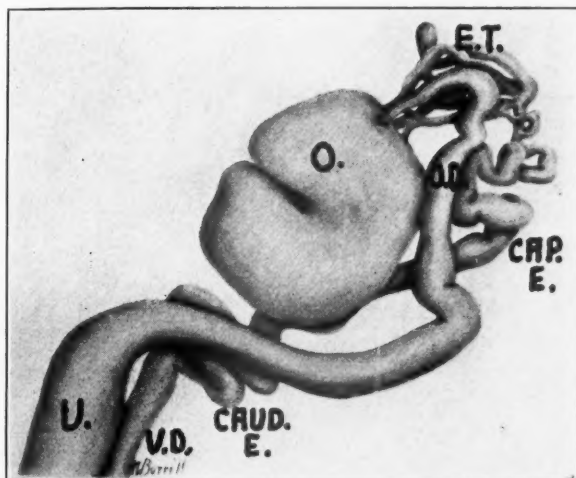


Fig. 6.—Left gonad region of newborn intersexed Rat 93-A. Drawing based on graphic reconstruction. O, ovary; E.T., efferent tubules; CAP.E., caput epididymis; CAUD.E., caudal epididymis; O.D., oviduct; U., uterus; V.D., vas deferens.

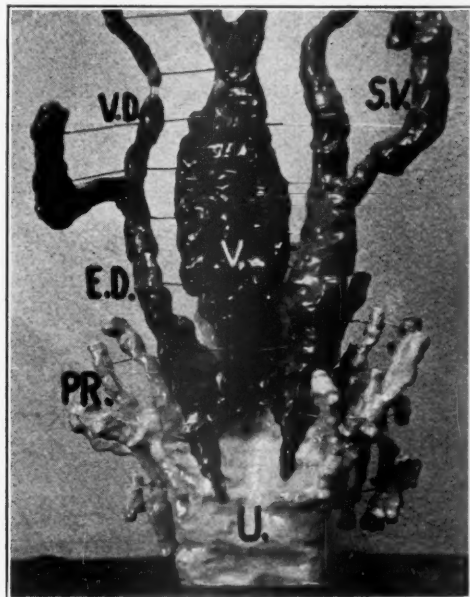


Fig. 7.—Wax plate reconstruction of part of urogenital region of newborn intersexed Rat 60-A, (dorsal view). The vagina of this rat communicates with the urethra bilaterally, but these communications are not patent. V., vagina; V.D., vas deferens; S.V., seminal vesicle; E.D., ejaculatory duct; P.R., prostatic diverticula; U., urethra.

Complete unilateral persistence of the Wolffian duct from gonad to urethra with anlage of efferent tubules, epididymis, seminal vesicles, and ejaculatory ducts, has been identified in 10 newborns. Complete bilateral persistence of these structures

has been found in 23 newborns (Figs. 6 and 7). A detailed study of the gonad and its accompanying tubules has not yet been made.

In a preliminary report on this subject,³⁰ it was stated that evidence of Müllerian duct inhibition had been found. Such evidence has been limited to that found in serial sections of 2 newborns. In all other newborns and in all adults to date, oviducts and uteri (the rat has a double uterus) have been present.

DISCUSSION

Other investigators have given androgenic substances to pregnant rats. Hain obtained resorptions with testosterone but noted a few successful deliveries with some of the synthetic androgens.³¹ She apparently did not study these offspring. Scipiades, in studying the effect of testosterone and testosterone propionate on the length of pregnancy, reported several deliveries of living young but made no remarks as to their morphologic condition.³²

While our work was in progress, Dantchakoff reported changes similar to ours in the forty-five-day embryonic female guinea pig. She obtained these changes by injecting solutions of testosterone propionate directly into the amniotic cavity of the fifteen-day intrauterine embryo. She has not reported any changes in adult animals to our knowledge. The presumption is that none of her animals survived to term.³³⁻³⁶ Since our preliminary note on this subject, our findings have been confirmed in the mouse by Raynaud³⁷ and confirmed in part in the rat by Hamilton and Gardner.³⁸

These findings seem to confirm Lillie's theory that it is a "male sex hormone" from the embryonic male that is responsible for the masculinization of the genetic female twin (free martin). However, certain differences exist between the free martin and our masculinized females. In the free martin, the Wolffian duct derivatives (the vas deferens, seminal vesicles, etc.) are stimulated, whereas, the Müllerian duct derivatives (oviduct, uterus, etc.) are inhibited. Its urogenital sinus and genital tubercle derivatives are usually not affected. Our animals show stimulation of Wolffian duct derivatives, but display little inhibition of Müllerian duct elements. The entodermal urogenital sinus derivatives show most marked changes. Two explanations for these differences may be advanced: (1) The male hormones in the two cases are not identical, since one is derived from embryonic testes and the other is an adult testicular principle; (2) the hormones are identical, but in the experimental animals the hormone is not effective as early nor for as long a period as in the free martin. Also, the total quantity of hormone acting on our animals may be less than in the free martin.

In well-masculinized animals only the upper two-thirds of the vagina is present. In some it ends blindly, in others the distal end communicates with the urethra by bilateral ostia. The remainder of the urethra presents a purely masculine appearance. In order to explain this condition, it is necessary to assume that the urogenital sinus is originally bipotential with respect to its sexual differentiation. It may give rise to the urethra, vestibular (Bartholin's) glands, lower vagina and other structures in the female, or it may give rise to the urethra, prostatic diverticula, Cowper's glands, etc., in the male. Interference with the

normal course of development in the genetic female by an excess of male sex hormone, then, would cause inhibition of the feminine tendencies (absence of lower vagina) and stimulation of the masculine tendencies (presence of prostates, etc.). The bilateral communications of the upper vagina with the urethra in some of our affected animals can only be interpreted as a persistence of the original junctions of the Müllerian ducts with the urogenital sinus. Thus the incomplete vagina which is found in these animals represents that portion of the normal vagina which is derived from the Müllerian ducts. The lower portion which has been inhibited must, therefore, normally arise from the urogenital sinus. This interpretation is at variance with some theories concerning the normal derivation of the vagina, although Koff³⁹ has found that the lower segment of the human vagina is derived from the urogenital sinus. Embryologic studies on the rat are being made to ascertain the accuracy of our hypothesis.

During the progress of this work, 2 cases of arrested development of the lower vagina in human beings, similar to the findings in our rats, have been brought to our attention (through the courtesy of Drs. H. O. Jones, Harry Culver, and W. T. Carlisle). These children had hypospadiac, penislike organs and apparently normal ovaries, Fallopian tubes, and uteri. Only the upper portion of the vagina was present, and it communicated with the urethra about 1 inch from the urethral meatus. So far as could be determined by palpation and abdominal exploration, no prostates or seminal vesicles were present. Hugh Young has reported 6 human beings with similar vaginourethral communications.⁴⁰ Von Neugebauer has reported many such cases.⁴¹ Several of these cases that came to the autopsy table were thoroughly dissected, and prostates and seminal vesicles were found.^{40, 41}

Womack and Koch first reported in 1930 that a substance having properties of the male sex hormone was found in normal human female urine and in normal human pregnancy urine.⁴² It is most interesting that this androgenic substance is not only present in normal human female urine, but that it is present in very nearly the same concentration that it is found in normal human male urine.⁴³ Estrogenic substance (female sex hormone-like substance) is found in normal male urine.⁴³ The concentration of estrogenic substance is relatively higher, however, in female urine than in male urine.⁴³ Androgenic substance has been found in normal human placentas^{44, 45} (and unpublished observations of the author). These facts make the results of our experimental work on rats of more than academic interest. Large amounts of androgenic substance injected into the mother rat have so influenced sexual development of the embryo that a masculinized female or an intersexed animal has resulted. It is conceivable then, that an *excess* of androgenic substance circulating in the pregnant human female may so influence sexual differentiation of the embryo that a masculinized human female or an intersex results.

SUMMARY

The production of intersexed rats by the administration of male sex hormone to the pregnant mothers of these animals is reported. The

embryonic development of genetic females is so modified that uteri, oviducts, and upper vagina; combined with epididymis, vas deferens, seminal vesicles, ejaculatory ducts, the various prostatic lobes, Cowper's glands, and a penis are found in the same adult animals. Indicative evidence that the lower part of the vagina is derived from the urogenital sinus in the rat is presented. It is suggested that an excess of androgenic substance in the human pregnant organism may be the causal factor in the production of some human intersexes.

The crystalline testosterone and testosterone propionate used in this work were generously supplied by the Schering Corporation and Ciba Pharmaceutical Products Inc.

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From their studies the authors show that acute inflammatory diseases of the female genitalia result in a marked sensitivity to insulin. This is the result of the decreased ability of the liver to store glycogen. Such a reaction could not be demonstrated when the inflammatory process was subacute or chronic. When the inflammatory process is virulent and widespread, the intermediate metabolism is disturbed as a result of damage to the liver parenchyma. No liver change could be demonstrated in extrauterine pregnancy. The resulting icterus must therefore be a hemolytic one rather than one of liver origin.

RALPH A. REIS.

TWO CASES OF INTERSEXUALITY*

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THE term "intersex," according to Goldschmidt, refers to those individuals who started out either male or female from a genetic standpoint but who, after a certain period, completed their sexual development in the opposite direction. In the intersex there is first a female phase and later a male phase, or vice versa, and in the second phase a typical mixture of both sexes exists. All true and pseudo-hermaphrodites are intersexes genetically.

It is exceedingly difficult to define sex from a biologic viewpoint and, according to Lillie, there is no such entity but rather a dimorphism into contrasting characters, whether they are biologic or psychologic. In a general way, sex is a fundamental attribute of nature and the exact mechanism is not fully known, although a special capacity of protoplasm, a regulatory force from the chromosomes, genes, and endocrine glands as well as environmental factors in the production of sex have been alluded to. Sexual deviations with the production of intersexes may then result from some unusual condition of the above four factors.

The following cases are presented because of certain recent investigations which seem to shed more light on their evolution, and also because we encountered problems in surgical procedure which did not seem to be sufficiently defined.

CASE 1.—J. L., a white female aged twenty years, married six months, entered the hospital Dec. 21, 1936, complaining of swelling in the right inguinal region for the past fifteen years which, for the past two months, had been painful. She stated that she had never menstruated. Coitus was painful but was undertaken about twice weekly. The patient had always been healthy, even escaping most of the childhood diseases. There was no family history suggestive of hermaphroditism, carcinoma, or syphilis, and venereal disease was denied.

Physical examination revealed an individual whose appearance was quite feminine. There was no evidence of hair on the face, chest, or in the axillae; only a few scattered black pubic hairs were noted. The hands and fingers were somewhat masculine in type, but the feet were distinctly feminine in size and shape. No laryngeal prominence was evident. The voice was that of a woman. The breasts were symmetrical and well developed. In the right inguinal region there was an egg-sized mass which was tender, mobile, not reducible to the abdominal cavity, and gave a distinct impulse on coughing. The left inguinal canal was normal. The appearance of the external genitalia, except for the absence of hair, was essentially normal. The clitoris appeared normal in size and in its relation to the urethral orifice. Skene's ducts and Bartholin's glands were not palpated. The vagina was short but elastic. Rugae were well established. The uterus was apparently absent. The adnexa were not palpated.

Laboratory findings were as follows: Blood pressure 120/80; hemoglobin (Sahli) 80 per cent; erythrocytes 4,500,000; leucocytes 7,400. X-ray picture of the sella turcica was negative; x-ray picture of the pelvis suggested masculinization. Basal metabolic rate was plus 4.

A diagnosis was made of the right inguinal hernia, Müllerian duct agenesis.

The patient was submitted to operation on Dec. 23, 1936. A modified Pfannenstiel's incision was extended to expose the right inguinal region. The abdomen was opened (Fig. 1). There was no evidence of uterus, Fallopian tubes, or vestigial structure. The left gonad was smooth, rounded, about 2 cm. by 3 cm., opalescent; no follicles were evident. It was attached to the wall of the pelvis by rather a firm band of peritoneum, resembling an atrophic infundibulopelvic ligament. On the right side a somewhat similar structure was prolapsed into the inguinal canal. This

*Presented at a meeting of the Chicago Gynecological Society, April 15, 1938.

was reduced into the abdomen and removed with its pedicle (Fig. 2). The gall bladder, liver, kidneys, and suprarenals were cursorily palpated and presumed to be normal. A prophylactic appendectomy was done, the hernia repaired, and the abdomen closed. The convalescence was satisfactory.

Pathologist's Report.—The external coat of the testis was composed of a dense, very cellular, fibrous tissue stroma, containing single smooth muscle fiber cells and moderately dilated capillaries. The larger blood vessels lying deeper in this capsule had moderately thickened walls, and surrounding them were small islands of nerve bundles and also islands of epithelial-like cells with large round to

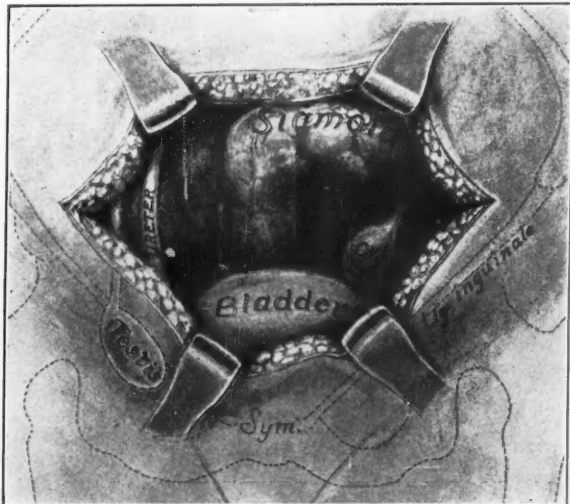


Fig. 1.—Showing findings at operation. The designation *Ov* on the left should be gonad, as no histologic proof was obtained that the tissue was ovarian.

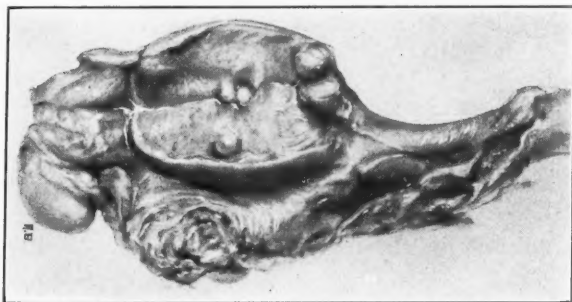


Fig. 2.

oval nuclei. The cytoplasm was slightly granular and in places vacuolated and also contained small brownish looking granules. The nucleus was composed of a finely reticulated chromatin material. In the deeper portions of the section there were islands of tissue composed of single tuboglandular structures lined by a high columnar epithelium with slightly elongated nuclei. The cell membranes of these cells were indistinct and their lumina appeared to be occluded (Fig. 3).

The chromatin of the nucleus was considerably more dense than those cells described above. About these tubular structures was a fairly dense capsule of connective tissue, containing swollen fibrocytes with pale staining oval to elongated vesicular nuclei. Surrounding these isolated tubular structures were large numbers

of cells with rather distinct cytoplasmic membranes and a distinct vacuolated cytoplasm. The nuclei of these cells were round to oval and vesicular with a reticulated chromatin network. Dispersed throughout these cells were small capillaries lined by a moderately swollen endothelium and supported by fine strands of connective tissue with swollen nuclei.

In addition, there were other islands composed wholly of a tubular adenomatous structure containing a more clearly defined lumen. The cells were columnar, the nuclei were oval in shape and similar to those described in the other islands of tissue.

Some of these cells formed solid cords and were separated from each other by dense infiltrations of connective tissue stroma containing large, elongated and slightly oval and occasionally irregular nuclei. These islands, however, were devoid of the epithelial-like cells that formed the interstitial stroma described in the other islands. Here and there one could see transitional stages, varying from just tubular structures to where occasional tubular structures were seen surrounded by large numbers of cells, Leydig-like in appearance and similar to those described above.

After van Gieson stain, the islands were composed wholly of tubular structure containing much connective tissue, whereas those containing Leydig's cells contained only fine strands of collagen fibers.

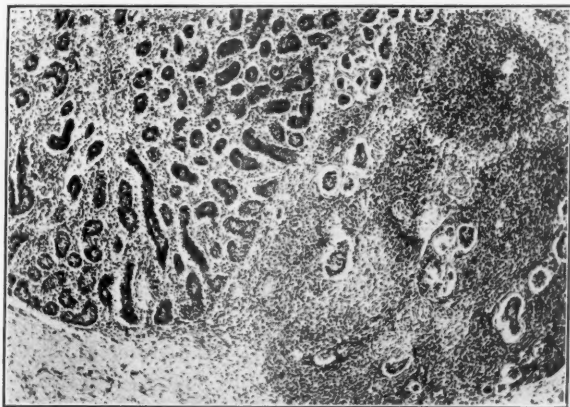


Fig. 3.

Sudan III stain revealed the Leydig fat cells filled with many fine sudanophilic droplets. Here and there were small groups of these cells which were free of fat droplets, and here they exhibit a more definite epithelial-like structure. Mitotic figures were not seen in this section.

Sections taken through the anatomical position of the funiculus revealed a dense fibromuscular stroma with a suggestion of small atrophic tubules in occasional areas. The lining of these tubules was composed of a flattened epithelium and a fairly thick-walled stroma.

None of the sections taken showed any evidence of ovarian tissue.

The postoperative hormone studies by Dr. Barnes were as follows: 2.6 mg. androsterone and 10 gamma of female sex hormone in a twenty-four-hour specimen of urine.

In a recent interview, the patient stated that the dyspareunia was less marked; that her sex appetite did not seem to be affected one way or the other by the operation, but that she believed she had been more jealous of her husband than formerly. Her weight had remained stationary. She seemed particularly to regret not being able to have children and inquired about the advisability of adopting a child.

CASE 2.—N. S., aged 3, sex undetermined. The following history was given by the mother. Until the age of six months no abnormalities were noted. The child's growth rate, teething, activity, etc., were normal. At about this time, however, the

mother noted that the clitoris was enlarging and becoming penislike. This continued to grow and erections were disturbingly frequent. To avoid the neighbors becoming aware of her problem, she had not permitted the child to play with other children and had kept the same maid. She described in tragic detail the fears of a parent with a child of undetermined sex. During the past year itching and dysuria had been noted occasionally and "pus in the urine" was found twice by the family doctor. Measles, frequent respiratory infections, chronic constipation, and three convulsions constitute her medical past. Her brother was nine years of age and was precociously developed; axillary and pubic hair was well established. The maternal grandmother had diabetes. The mother had repeatedly taken thyroid extract and was taking thyroid while pregnant with this child.

The general examination revealed a well-developed, well-nourished child who appeared distinctly feminine. The abnormalities noted in the teeth were some separation of the incisors; in the hands there was a slight incurving of the last phalanges of the little fingers. Both hands were broader than normal. The body weight, height, and trunk extremities were normal. The laryngeal prominence was not palpated. On inspection of the genitalia, there was an abundant growth of thin, brown curly hair about the vulva. The clitoris was a dangling penislike structure with a somewhat redundant prepuce. At its base there was an opening, the urethra. There was a suggestion of labia majora but no labia minora, hymen, or vaginal orifice. Bimanual palpation through the rectum detected a small uterus. The ovaries were not palpated nor was there any structure suggestive of a prostate.

Cystoscopic Report by Dr. Harry Culver: By hugging the roof of the urethra, a No. 21 F. cystoscope was readily passed into the bladder which appeared to be normal. On the floor of the urethra, 2 cm. from the vesical orifice, was an opening. Through this the cystoscope passed for a distance of 3 cm. into a pouch lined by typical vaginal epithelium. The opening of the vagina into the urethra was 2 cm. distant from the urinary meatus.

Laboratory Findings.—Repeated urinalyses, blood and stool examinations were normal. Blood chemistry: nonprotein nitrogen 33 mg., sugar 93 mg., cholesterol 140 mg. per 100 c.c. of blood; sugar tolerance 93, 168, 93, 91. Wassermann negative. Basal metabolic rates were minus 30 and minus 23. Cholesterol determinations on the same days were 140 and 154. Hormone studies by Dr. Barnes showed androsterone 0.2 mg. and a trace of female sex hormone.

A diagnosis was made of female pseudohermaphroditism with masculinized external genitalia.

On Nov. 29, 1937, a laparotomy was done for further study of the internal organs. There were an apparently normal uterus, tubes, and ovaries with normal relations and ligamentous supports. Two punch biopsies were taken from the right ovary. As the left ovary was identical, it was not disturbed. Careful search was made for other gonadal structures. Dr. Culver palpated the kidneys and suprarenals and believed them to be normal. A prophylactic appendectomy was done. The abdomen was closed and the phallus removed according to the technic of Hugh Young. The convalescence was satisfactory.

The histologic report of the ovarian biopsies was normal ovarian tissue with many miniature Graafian follicles. The embryologic explanation of this case is that there was apparently an inadequate stimulus for development of the sinovaginal bulb into the normal structures of the external genitalia. The Müllerian tubercle and urogenital sinus, instead of descending to form the vulval cleft, remained in the position of much earlier development, so the external evidence of a vagina was not present.

The next problem was the determination of the optimum time in this child's life for the reconstruction of the vagina. In reviewing other case reports of this condition, which is by no means a rare one, we were unable to find any discussion or reference to the time when a vaginal plastic of this type would be most likely to afford a good functional result. From a psychologic viewpoint, the earlier the time the better. The external genitalia of this child are now, however, not unlike a normal female child.

In several instances in which the operation was done in infancy, the problem of follow-up dilatations was irksome to the patient, family, and attending physician. Having in mind the influence of estrogenic substance on vaginal hypertrophy, it is our plan to do the plastic operation after the onset of puberty.

SUMMARY

Two cases are presented: One a wife with a right testicular-like gonad, a Müllerian duct agenesis, normal external genitalia, and a peculiar absence of body hair. The other case is that of a girl aged three years with a penislike phallus, normal female internal genitalia, and masculinized external genitalia. With the advancing knowledge of endocrinology, genetics, and embryology, it is hoped that these individuals with indefinite sex may be afforded a better opportunity for physical and psychic adjustment to the social scheme.

6 NORTH MICHIGAN AVENUE

DISCUSSION

DR. WALTER SCHILLER.—Up to twenty years ago we had no embryogenetic explanation for the various malformations of genital organs presenting characters of both sexes in one individual, and consequently had no logical system of classification.

Kermauner, who wrote an extensive monograph on the subject, pointed out that these monsters have a combination of male and female sex characters which are assembled without rhyme or reason and thus make a logical explanation impossible. This negativistic attitude of pathologists has changed since Moszkowicz, of Vienna, published his papers on human intersexes. His work is founded on the discoveries of Goldschmidt, of Berlin, which were carried out on butterflies. Moszkowicz most successfully applied Goldschmidt's theories in the field of human pathology. The main point is that sex is determined by chromosomes at the time of fertilization of the ovum. In normal individuals by predominance of one or the other type of sex chromosomes, the sex is fixed and determined in one direction and consequently the primarily ambiguous, "anlage" of sexual organs and characters develop during embryonic life, in one direction. In abnormal cases, the primarily predominant and determining chromosomes lose their power and the chromosomes of the opposite sex succeed in determining power. This occurs at a time called rotation point. Each hermaphrodite, or as we prefer to say, intersex, is sufficiently characterized by its primary sex and the time of the rotation point within the period of the embryonic life. Moszkowicz has published detailed diagrams, demonstrating normal developing of sexual organs and characters for each month of intrauterine life. Comparing the findings of the individual intersexes to these diagrams, it is very simple to determine the primary and the secondary sex, as well as the date of the rotation. Instead of the complicated and vague descriptions of former times, today we are characterizing an intersex by two statements only; first, of what sex was the individual primarily, second, when did the rotation in the secondary sex occur?

Goldschmidt, in his papers, insists that human intersexes all are primarily female and secondarily male. During the last few years we have seen a few cases that disprove this statement, being examples of the primary male and secondarily female type. There is, however, no doubt that the majority of the human intersexes are as Goldschmidt has said, primarily female and secondarily male. The most common type are individuals that are of female appearance, with well-developed female secondary sex characters and female sex feelings. Genitalia present a well-developed female vulva, a short, poorly developed vagina, poorly developed uterus and tubes, and instead of ovaries, testicles of almost normal size, situated in the labia majora. It is very likely that such individuals are not only abnormalities in the anatomic, but abnormalities in the hormonal sense, also. Their sexual life and feelings are female but supported by male hormones. Some of these individuals,

when the testicles were removed by surgery, developed very severe signs of menopause which proved resistance against female hormones but disappeared when male hormones were applied.

The first case of Dr. Carlisle is not only an intersex but a severe type of developmental deficiency, since the products of the Müllerian ducts are missing. The lack of pubic and axillary hair also is a developmental deficiency, since pubic and axillary hair belong to both sexes. The second case belongs to the very small group of primarily male and secondarily female intersexes. For this case it is very difficult to figure out the rotation point. It seems that there is a possibility of a rotation, an incomplete turning back to the primary sex for a short spell, and again another rotation, which would explain the combination of sex characters that cannot be explained by one rotation point only.

SOME OBSERVATIONS ON THE INFECTIOUS AGENTS CAUSING LEUCORRHEA DURING THE CHILDBEARING PERIOD

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FROM a study of 1,975 patients examined during a venereal disease survey in Tallahatchie County, Mississippi, in 1937, 399, or 20.2 per cent, gave leucorrhea as a chief symptom. Three hundred and eighteen of these women were in the childbearing age and 81 had passed the menopause. The laboratory study of these cases forms the basis for this report.

Leucorrhea in varying degrees is such a common finding in adults that many women think of it as being a normal condition. This attitude on the part of the patient has been supported to some extent by the general practitioner who, too often after excluding cervical lacerations or uterine malposition, thinks of only one infectious etiologic agent, gonococcus. In patients showing leucorrhea, the laboratory diagnosis consists chiefly of a dried urethral or cervical smear stained by the Gram stain method or methylene blue. It should be remembered that such smears are not ideal for a scientific diagnosis of leucorrhea due to *Trichomonas vaginalis*, a protozoan or *Monilia albicans*, a member of the Hyphomycetes order.

LABORATORY DIFFERENTIAL DIAGNOSIS OF INFECTIOUS LEUCORRHEA

There are several infectious agents which should be considered in patients who present the symptom of leucorrhea as a primary complaint during the childbearing age:

1. *Neisseria gonorrhoeae*.—A dried, stained, smear from the cervix or urethra will show gram-negative extra- and intracellular diplococci. In doubtful cases, a culture of the cervical or urethral pus on a chocolate blood agar plate will give the positive test of Gordon and McLeod.¹

2. *Trichomonas vaginalis*.—A suspension of the fresh pus in isotonic magnesium sulphate, when examined under the microscope with the low or high power lens, will show the very active flagellate, which is about the size of a leucocyte.

3. *Hemophilus Ducreyi* Causing Ulcerations of the Cervix or Vaginal Wall.—A culture of the pus, streaked on a chocolate blood agar plate, shows slightly hemolytic white colonies of about 0.25 mm. in diameter after twenty-four hours incubation at 37.5° C. Phenol toluidine blue stain from these colonies shows small diplobacilli of 1.5 by 0.5 microns. They are gram-negative. The Dmelcos' skin test is positive.

4. *Monilia albicans*.—A suspension of the fresh pus in 10 per cent NaOH, when examined under the microscope with the low or high power lens, shows the characteristic budding. A stab culture of the fresh pus inoculated into a tube of gelatin and cultured at room temperature will show the characteristic "inverted pine-tree" growth in ninety-six hours.

5. *Various Streptococci and Staphylococci*.—The Gram stain made from the pus will show the presence of these organisms. A streak on a blood agar plate with subculture to gelatin will complete the identification.

6. *Corynebacteria*.—A direct smear stained with methylene blue and by the Gram stain method will show the characteristic organisms. A culture on Loeffler's serum agar, after 18 hours growth at 37.5° C., and stained by the same method as the direct smear, will confirm the diagnosis.

7. *Vincent's Spirillum*.—A direct smear stained with the Gram method will show the characteristic organisms. One must always keep in mind the frequent occurrence of nonpathogenic spirochetes and the presence of the Döderlein bacillus in the vagina.

PROCEDURE

A. Direct smears were made from the cervix and urethra and stained by the methylene blue and the Gram-staining techniques. The cervical smears were taken after insertion of a vaginal speculum.

B. Hanging drop wet preparations were made from the same fresh material by suspending it in isotonic magnesium sulphate solution and 10 per cent NaOH, and were studied for *Trichomonas vaginalis* and *Monilia albicans*.

FINDINGS

TABLE I. THE FINDINGS FROM LABORATORY EXAMINATION OF URETHRAL OR CERVICAL PUS FROM 318 LEUCORRHEA PATIENTS BETWEEN THE AGES OF 15 AND 44 YEARS

NAME OF ORGANISM	NUMBER POSITIVE	PERCENTAGE POSITIVE
Gonococci	181	56.9
Staphylococci	84	26.4
<i>Trichomonas vaginalis</i>	57	17.9
Streptococci	36	11.3
<i>Monilia albicans</i>	10	3.1
<i>Hemophilus ducreyi</i>	6	1.9
<i>Vincent's spirillum</i>	3	0.9
<i>Enterobius vermicularis</i>	2	0.6

There were 35 patients showing leucorrhea who did not show any of the organisms listed in Table I. They showed one or more of the following miscellaneous organisms: *Bact. coli*, micrococci, Saprophytic spirochetes and mycobacteria; *Vibrio*, *Enterococci*, *Bacterioides*, and the Döderlein bacillus.

Of the 318 leucorrhea patients, 6, or 1.9 per cent, gave a positive Frei test.

Various members of the miscellaneous group of organisms also appeared from time to time in the pus containing the other more pathogenic organisms listed in Table I. In some cases, more than one pathogenic organism was found in the same patient. In general, gonococci were not found in pus containing a large number of the trichomonas, or monilia or Döderlein bacilli. There is an apparent antagonism between

them. The relative incidences of streptococci and staphylococci were greatest in those cases that gave a history of abortion or miscarriages within the last year. In some cases, under the miscellaneous group, there was a history of repeated use of concentrated chemical douches which should be considered in the etiology.

TABLE II. FINDINGS FROM LABORATORY EXAMINATION OF URETHRAL OR CERVICAL PUS FROM 81 PATIENTS OVER FIFTY YEARS OF AGE (AFTER THE MENOPAUSE)

NAME OF ORGANISM	NO. POSITIVE	PERCENTAGE POSITIVE
<i>Trichomonas vaginalis</i>	47	58.0
Gonococci	10	12.3
<i>Monilia albicans</i>	9	11.1

The miscellaneous group was not worked out in this series.

TREATMENT

Table III shows the laboratory results from the uses of sulfanilamide in the treatment of 176 cases of gonorrhea in women without the presence of *Trichomonas vaginalis*, 25 cases showing both the gonococcus and the trichomonas, and 79 cases of *Trichomonas vaginalis* infection without the presence of gonococci.

TABLE III

NO. CASES AND LAB. FINDINGS BEFORE BEGINNING THERAPY	AM'T. OF SULFANILAMIDE GIVEN BY MOUTH IN 8 DAYS	LAB. FINDINGS 2 WK. AFTER BEGINNING TREATMENT			
		NO. POS. FOR G.C.	% POS. FOR G.C.	NO. POS. FOR TRI-CHOMONAS	% POS. FOR TRI-CHOMONAS
176 Positive for gonococci	240 gr.	46	25.9	0	0
25 Positive for both gonococci and <i>Trichomonas vaginalis</i>	240 gr.	20	80.0	24	96
79 Positive for <i>Trichomonas vaginalis</i>	240 gr.	0	0.0	75	95

The sulfanilamide was given in doses of 10 gr. four times per day, for the first four days; and 5 gr. 4 times per day for the next four days. No other therapy was given. When the check up was made two weeks after beginning the therapy, not only was there a marked drop in the number of positive smears by laboratory study, but the leucorrhea symptoms were markedly improved. In the *Trichomonas vaginalis* group, there was very little noticeable improvement. These cases, however, showed rapid improvement when put on vaginal douches, with acetylaminohydrorphenylarsenic acid (Devegan) every night for a week before, and just after a menstrual period. In the cases where gonococci and *Trichomonas vaginalis* were both present, the sulfanilamide therapy was combined with the douches with good effects. A few patients did not return for the check up, or were menstruating at the time of the check up and do not appear in the final analysis. Many of the more resistant cases were chronic salpingitides.

CONCLUSION

The frequency with which nongonococcal organisms appear in cases of infectious leucorrhea warrants at least an examination by microscope and culture if necessary for *Trichomonas vaginalis* and *Monilia albicans*. This is especially important where one is going to use sulfanilamide therapy. Sulfanilamide therapy is most effective when used in acute cases of gonorrhea, and has no significant effect on leucorrhea due to *Trichomonas vaginalis*. There is an apparent antagonism between *Trichomonas vaginalis*, *Monilia albicans*, and Döderlein bacilli against the gonococcus in vivo.

REFERENCE

- (1) Gordon, J., and McLeod, J. W.: J. Path. & Bact. 31: 185, 1928.

A CASE OF ACEPHALUS HOLOACARDIUS*

HENRY BUXBAUM, M.D., AND DAVID V. WACHSMAN, M.D., CHICAGO, ILL.

(From the Service of the Chicago Maternity Center)

THIS case of a parasitic monster is reported because of the rarity of its occurrence. There have been 20 similar cases reported under different designations, which would seem to infer a definite need for a standardization of nomenclature in attempts to describe different types of fetal abnormalities. Monsters resembling ours have been called amorphous acephalus, acardiacus acephalus, and, better still, acephalus holoacardius, which is more descriptive of the case herein reported.

The patient was a white, 21-year-old gravida iii. Her family history was essentially negative with no record of any multiple pregnancies or monstrosities in either her or her husband's antecedents. She had the usual diseases of childhood with no serious ailments or operations since. Her menstrual history was normal; onset at the age of ten years, twenty-eight-day type of five days' duration. The last menstrual period started on June 18, 1937, and the estimated date of confinement was March 27, 1938. Her previous obstetric history revealed two previous pregnancies, both terminating spontaneously in two normal living children. Her present pregnancy was uneventful; blood pressure and urinalysis were always normal, and she had no serious complaints throughout her prenatal period. Weight gain was slight: from 67.7 to 69.5 kilograms. Labor started March 21, 1938, at 2:30 A.M. The first and second stages proceeded rapidly, lasting forty-five minutes, and she was delivered in her own home on the out-patient service of the Chicago Maternity Center at 3:15 A.M. of a normal living female child, weighing 3,720 gm. Ten minutes later the placenta, found to be detached, was delivered by simple expression. Estimated amount of blood loss was 250 c.c. Attached to the fetal surface of the placenta was an irregular mass enclosed in an intact amniotic sac, containing about 20 c.c. of clear liquor amnii (Fig. 1). The patient's condition was good; no anesthetic was required, and she had an uneventful puerperium, getting out of bed on the eighth day and was discharged as well with her normal baby on the fourteenth day.

Description of Specimen.—The placenta was intact, measured 18 by 20 by 3 cm. and weighed 720 gm. The maternal surface was normal but on the fetal surface was the globular mass shown in Fig. 1, enclosed in its intact amniotic sac. Upon rupture of the sac the monster shown in Fig. 2 was found attached to an umbilical cord, measuring 16 cm., which was attached to the fetal surface of the placenta about 8 cm. from the attachment of the cord of the normal infant. There was definitely one placenta, one chorion, and two separate amnions. This monster measured 12 by 12 by 8 cm. and weighed 1,320 gm. It consisted of two well-

*Read at a meeting of the Chicago Gynecological Society, April 15, 1938.

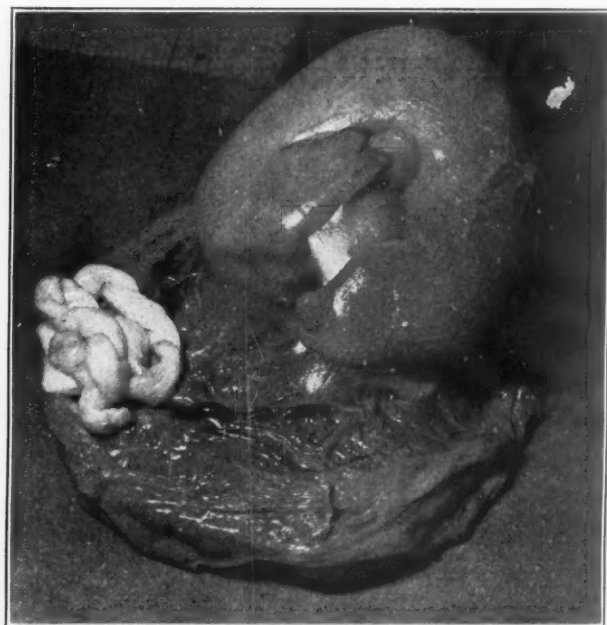


Fig. 1.

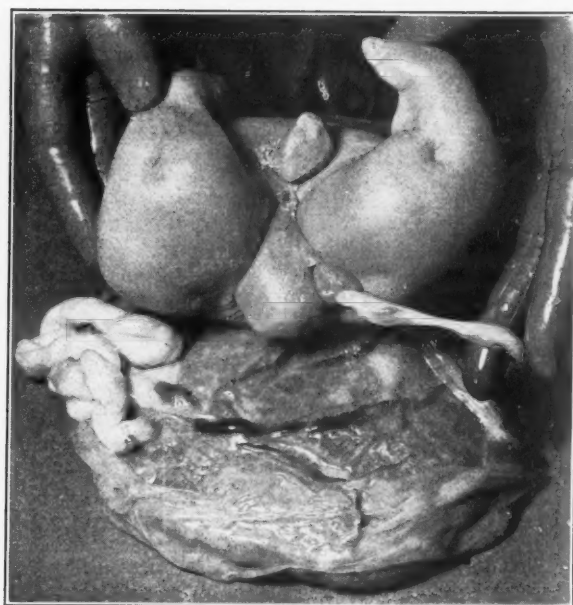


Fig. 2.

developed thighs and two legs ending in feet with two toes on each foot. Both feet were of a talipes equinovarus. The top of the mass was round and smooth, and the whole thing was covered with a pink, healthy-looking epidermis. Between and a little above the thighs on the anterior wall was a structure closely resembling a penis with a dimple below the tip that resembled a urethra. The cord was inserted at the base of the left thigh. The circulation in the monster appeared good. Fig. 3 is an x-ray picture of the monster and shows a pelvic girdle, two femurs, two tibiae, one fibula, and a few metatarsal bones on one side.

DISCUSSION

This case is interesting from several standpoints. In the first place, although this is definitely monozygotic twins, one of the babies is a female and the other one apparently a male. Also the origin of the circulation in the monster is a matter of conjecture. Inasmuch as no heart is evident in the monster, its blood supply must



Fig. 3.

have come from the normal baby via an anastomosis of blood vessels in the placenta, and even if an embryonic heart originally existed in the monster, it had no doubt been overcome, then superseded by the heart of the healthy baby, with resulting atrophy and complete disappearance, a conclusion not altogether illogical. Therefore, this was not only a monster but a parasite as well. It is interesting to note at this time that the well baby revealed no cardiac hypertrophy on physical and radiologic examination.

Inasmuch as the cause of these peculiarities in embryology is still a controversial topic, one hesitates to venture an opinion whether hereditary or environmental factors are responsible but from the facts presented in this particular case, one may be justified in assuming that environment was the sole factor involved, on the basis that here is a uniovular twin in which one baby, getting more than its share of nourishment, completely overcomes and dominates the nutrition of the weaker baby which ceases to develop and becomes a parasite, depending for its maintenance upon the healthy baby.

PRIMARY CANCER OF THE VAGINA*

FREDERICK V. EMMERT, M.D., F.A.C.S., ST. LOUIS, MO.

(From *The Barnard Free Skin and Cancer Hospital*)

PRIMARY carcinoma of the vagina is not common. Of all cancers, in women, it occurs in less than 1 per cent, while in genital cancer, it occurs in 2.7 per cent (Taussig).

I have investigated the material at The Barnard Free Skin and Cancer Hospital and found 30 cases of primary carcinoma of the vagina. During the same twenty years, we have seen 1,546 cases of genital cancer, so that the incidence is 1.09 per cent. It is hardly necessary to point out that secondary carcinoma of the vagina has been excluded. To these 30 cases, I have added 4 cases from the private practice of Dr. Taussig, and 3 from that of the late Dr. Gellhorn. The following study, therefore, is based on 37 cases of primary cancer of the vagina.

As to the age of the patients, the youngest was 26, the oldest 82. The majority were between 45 and 60 years, the average being 53. This corresponds fairly well with other statements in literature. In 1930, Baldwin could collect but 3 cases in patients less than 20 years of age with cancer of the vagina.

Concerning the location, all authors agree that primary carcinoma develops in the posterior fornix most frequently. In our 37 cases, this was found to be true 14 times; 5 originated in the anterior wall; 13 were located on the lateral walls and 6 were annular in shape. Rohde found of 123 cases, 71 on the posterior wall, 23 on the anterior wall, 13 on the lateral wall, and 16 of the ring-type encircling the vagina.

Previous labors seem to have very little to do with the etiology, for out of 37 cases, there were 7 nulliparous women. Moreover, if parity had any influence, primary carcinoma should be much more common.

Cancer of the vagina is either ulcerative or papillary in type and occurs in single and less often multiple lesions. In our cases, 24 lesions were single and 13 multiple, 26 being nodular, and 11 ulcerative. Microscopically, cancer in this location is of the squamous cell type. In 30 cases in which we have definite data, we found this to be the case in 29. The remaining case, which is from Dr. Gellhorn's private practice, was one of adenocarcinoma in a young woman of 27 years.

The histologic grade was determined on the basis of cellular differentiation of the specimen according to the method of Broders. All tissues available at this time are squamous cell carcinoma, and of these 13 cases studied, 8 were Grade II, and 5 were Grade III. This is too small a series from which to deduce any factors of significance as to any specific features of the histology of vaginal carcinoma. Thus, none were of the markedly highly differentiated or undifferentiated types.

*Read before the St. Louis Gynecological Society, January 11, 1935.

In our 37 patients, 31 had hemorrhage, one noticed slight bloody discharge after intercourse, the remaining 5 did not remember any such symptoms.

Of the 37 patients of our series, the first 4 were treated purely palliatively with acetone, because their condition was far too advanced for any hope of cure. Seven patients received no treatment or were treated elsewhere and cannot be considered in this connection. Of the remaining 26, 21 were treated with radium applied in various forms. From these 21, 2 must be deducted because lacking follow-up. Of the 19, 4 are still alive, namely 11, 8, 7, and 1 years, respectively, after treatment. Five patients were subjected to radical vaginal colpectomy and hysterectomy, with one postoperative death 5 days later. Of the remaining 4, 2 are alive and well, 6½ and 1½ years, respectively, after operation. A third case is alive but with recurrence. The one remaining patient died 3 years after operation.

If we may draw conclusions from a limited material, and from an experience extending over 20 years, we must admit that the hopes based on operation and radium therapy have not yet been fulfilled. Out of 33 cases treated over five years ago, only four remained well, three following radiation, one following operation, an absolute curability of 12 per cent. Considering only those cases that were treated with radium or by operation, we have a total of 26 cases with five-year cures in four, making a salvage of 15 per cent. It must be admitted that the radical operation undertaken in the five cases is quite different from the simple surgical excision and requires a degree of technical skill, since the paravaginal tissues and practically the entire vagina must be removed.

The problem, therefore, is still in abeyance. The suggestion I wish to make tentatively at this moment is this, that in the early stages a really radical operation be performed and radium with or without x-rays be applied in more advanced cases of primary carcinoma of the vagina.

METROPOLITAN BUILDING

Benthin, W.: *Genital Disease in the Menopause*, Med. Klin. 34: 605, 1938.

Among 565 women in the menopause Benthin found that 244 (44 per cent) complained of bleeding, 139 (25 per cent) had descensus and prolapse of the uterus, 77 (13.9 per cent) had an ovarian tumor, 7 (1.2 per cent) had uterine fibroids, 15 (2.6 per cent) had other genital ailments, 42 (7.7 per cent) had bladder symptoms, 23 (4.1 per cent) had intestinal ailments, and 18 (3.2 per cent) had nongynecologic conditions.

Among the 244 bleeding cases 114 (46 per cent) were of benign origin and 130 (54 per cent) were from malignant disease. Among the 77 ovarian tumors, carcinoma was present in 39 cases (50 per cent).

It is interesting to observe that inflammatory disease, which forms 90 per cent of the ailments of women in the reproductive years, was almost completely absent in the menopause. Likewise endocrine disturbances other than menopausal symptoms played no role.

J. P. GREENHILL.

LIVER PRESENTATION*

REPORT OF TWO CASES

EDWARD ALLEN, M.D., CHICAGO, ILL.

STANDARD textbooks of obstetrics do not mention presentation of a baby by its liver. Because of the apparent infrequency and difficulties arising in differential diagnosis, it would seem that a report of two such cases might be of interest.

CASE 1.—Mrs. L. C. S., aged 20 years, primipara, had her last menstrual period April 7, 1932. Pregnancy progressed normally until September 16, when she reported to the clinic stating she had passed 5 to 10 drops of bright red blood from the vagina two days previously. No evidence of bleeding was found and the resident in obstetrics instructed her to return in two weeks. On September 18 she again reported to the clinic, saying that the night before she had suddenly lost about one quart of clear fluid from the vagina. No fluid could be seen coming from the vagina and on rectal examination the cervix was noted as firm, long, and not dilated. She was sent home to remain in bed for twenty-four hours. At her next visit on September 30 she stated that small quantities of fluid which she did not believe was urine still escaped from the vagina. Fetal heart tones at this time were normal. The same complaint and findings were again noted on October 10. On November 18 the patient returned, complaining of backache and abdominal tenderness. At this time the fundus of the uterus was 28½ cm. above the symphysis, ballotable head in the fundus and heart tones were heard in the upper quadrants. Rectal examination did not reveal any change from previous examinations.

On the morning of November 28 the patient was admitted at 8 A.M., stating that bleeding had begun at 6:30 A.M. and was still present; she believed she had lost about a cupful of blood. Slight pains began at 7 A.M. and were continuing. Fetal heart tones were not heard but fetal movement was felt by the mother and the examiner. No rectal examination was made. The blood pressure was 124/80 and the hemoglobin 55 per cent. The discharge from the vagina seemed to be blood-tinged amniotic fluid. The patient's condition remained the same until 2:30 P.M., when pains began every five to seven minutes, lasting twenty to thirty seconds. There was no increase in the bleeding. At 4 P.M. ¼ gr. of morphine sulphate was administered. At 11:30 P.M. there was a sudden increase in the vaginal bleeding and pulse had risen to 120. The patient stated definitely that she felt fetal movement although the heart tones could not be heard. Her husband was typed for a blood transfusion.

When I saw the patient for the first time at 1:30 A.M. there was a steady trickle of bright red blood from the vagina. The maternal pulse rate had risen to 136; blood pressure was 140/88 and temperature 99.2° F. No fetal heart tones could be heard. Vaginal examination revealed a soft boggy mass completely filling the cervix which later was found to be the fetal liver. The cervix was about two-thirds dilated. Brisk bleeding accompanied the examination. On more careful examination it was found that two fingers could be slipped by the mass and the examining fingers seemed to meet the unruptured bag of waters. These were ruptured and a large amount of clear straw-colored fluid escaped. On further introduction of the hand into the uterus, difficulty was experienced in feeling fetal parts, which we later found was due to the fact that the hand had been introduced directly into the abdominal cavity of the fetus. Further manipulation allowed us to grasp both feet which were drawn gently through the cervix. Constant traction was maintained, and at 2:15 A.M. a six-pound dead fetus was delivered. The placenta delivered normally a few moments later.

*Presented at a meeting of the Chicago Gynecological Society, Clinical Meeting, April 15, 1938.

Examination of the fetus revealed an almost total absence of the anterior abdominal wall with the liver protruding through it still oozing blood from cracks in its capsule. The bladder had been ruptured and was collapsed. Both anus and urethra were imperforated.

CASE 2.—Mrs. D. H., aged 26 years, had had three normal full-term children, in 1927, 1929, and 1931, respectively. The last menstrual period was Sept. 6, 1933. The patient had attended the cardiac clinic because of a mitral stenosis, but the heart was well compensated. The blood pressure had varied between 110/70 and 120/70, and the urine did not contain albumin or sugar. Labor pains began at home at 7:30 A.M., May 11, 1934. At 12 o'clock the membranes ruptured spontaneously. The patient was examined by the resident on the out-patient service at 5:30 P.M., and a diagnosis made of right sacrum anterior and probable placenta previa. At this time the patient was bleeding steadily from the vagina. The pulse rate was 120, irregular and weak. The fetal heart tones were 120 in the left lower quadrant. Immediate transfer to the hospital was ordered.

Upon arrival at the hospital the fetal heart had slowed to 80 beats per minute and before the patient could be prepared for vaginal examination they had ceased. Six per cent glucose solution was started at once intravenously as the vaginal bleeding was more pronounced and the maternal pulse had risen to 160. Vaginal examination revealed a rather firm mass filling the almost completely dilated cervix. Rather profuse bright red bleeding was produced by the examination. Inspection of this mass by means of vaginal retractors showed the smooth capsule of the liver broken here and there by fissures from which considerable blood was flowing. Under deep anesthesia the liver was gently replaced in the uterus, both feet were grasped and brought into the vagina. Delivery of the body was accomplished easily, but there was insufficient dilatation of the cervix to permit passage of the rather large after-coming head. Perforation of the skull was accomplished by slipping the anterior lip of the cervix forward and entering the cranial cavity at the base of the skull. The placenta was expressed, leaving a small piece in the uterine cavity, which was removed manually. Blood transfusion was not given although a compatible donor was present. Hemoglobin was 78 per cent. The patient left the delivery room in fair condition. Puerperium was uneventful.

The fetus weighed 5 pounds. The absence of the anterior wall permitted exstrophy of almost all the abdominal organs. There was a rather large spina bifida.

SUMMARY

Two cases of liver presentation are described, illustrating the need for care in the diagnosis of central placenta previa in the last trimester of pregnancy. Cesarean section in most clinics is the accepted treatment for the central variety of placenta previa. Gross fetal abnormalities which are not demonstrable by roentgenography may produce the clinical picture and vaginal findings of central previa and should be considered in the differential diagnosis.

55 E. WASHINGTON STREET

Martines, S.: *The Content and Elimination of Iron in Breast Milk*, Riv. Ital. di ginec. 20: 467, 1937.

The author found that the iron content of breast milk is 2.7 mg. per liter, is greater than in colostrum, and is independent of the intake of food. The milk of multiparas is richer in iron than that of primiparas.

In a group of lactating mothers, placed on iron therapy, a remarkable increase in iron was noted in the milk.

The author highly recommends the administration of iron during lactation, especially when anemia is present.

AUGUST F. DARO.

SARCOMA OF THE UTERUS*

WITH REPORT OF THREE CASES

W. C. DANFORTH, M.D., EVANSTON, ILL.

SINCE the month of June, 1936, three patients with sarcoma of the uterus have appeared in our service. As it had been some years since we had seen a case, it seemed of interest that these three should be seen within a limited time. Sarcoma of the uterus has been regarded as a fairly rare tumor. Some years ago Evans estimated, after studying a considerable number of cases, that sarcoma appeared about once in 40 cases of malignant tumor of the uterus. In view of the short time in which these three patients were seen it may be fair to inquire whether a more thoroughgoing study of pathologic material might not show a greater incidence than we have hitherto assumed. During the period covered by this report there were 178 myomas of the uterus. In 123 of these the myoma was the primary reason for treatment and in 51 it was of secondary importance. In 4 cases the myoma was in the cervix. The incidence of sarcoma as compared with myoma was one to 59. During the same period there were 25 carcinomas of the uterus, of which 15 were of the cervix and 10 were corporeal. During this brief period, therefore, the frequency of sarcoma as compared to cancer was one to 8.33. This incidence is higher than we heretofore believed and cannot be regarded as authoritative because of the small number of cases. Preoperative diagnosis of sarcoma is difficult to make. In all of these cases the diagnosis was first made in the laboratory. The rather characteristic appearance of the gross cut surface may give reason to suspect sarcoma.

The case histories in brief are as follows:

CASE 1.—June 20, 1936. Patient, aged 39 years. Referred by Dr. J. G. Carr. She complained of low backache and pain in the left lower abdomen. Her last period had been profuse. Examination showed an ovoid mass on the left side as large as a coconut. Operation disclosed an endometriotic cyst on the right side and a spherical fibroid tumor of the uterus. On the left side was a smaller endometriotic cyst.

Extract from pathologic report: "A very cellular sarcoma in the wall of the uterus, growing beyond the limits of encapsulation of the fibroma in which it arises with large hyperchromic, many shaped nuclei. Mitotic figures are very rare, but the tumor is definitely malignant and invasive."

CASE 2.—July 15, 1937. A woman of 47 years. Referred by Dr. Arthur Colwell because of bleeding apparently caused by a large fibroid. Steady though not profuse bleeding had gone on for three weeks prior to admission to the hospital. Subtotal hysterectomy was done. Recovery was uneventful. The pathologic report was as follows (extract from pathologic report):

"The huge tumor is composed of pleomorphic cells with irregular vesicular round basophilic nuclei and eosinophilic cytoplasm. Some of the cells are round, others are narrow, elongated with a fibrillar structure. Marked irregularity in size, shape, contour, and staining affinities are present. In some field retrogressive changes

*Read at a meeting of the Chicago Gynecological Society, April 15, 1938.

are prominent, in others active growth is demonstrated by numerous mitotic figures. Numerous thin-walled blood vessels are seen surrounded by round and elongated cells attempting to form fasciculae. In such regions of good blood supply, growth is abundant. Necrosis and degeneration occur distant to the blood supply.

"Diagnosis: Intramural fibromyoma with sarcomatous degeneration. Right cystic ovary and oviduct."

CASE 3.—Sept. 22, 1937. A woman of 62 years had suffered from uterine bleeding for several weeks. About ten days before she was brought to us she passed a spherical mass which was pronounced fibroma uteri in a diagnostic laboratory in Florida. Examination disclosed a large irregular uterus extending to within an inch of the umbilicus. The os was about 2 cm. wide. Subtotal hysterectomy was done, the uterus being opened for inspection immediately. A large tumor mass projected into the uterine cavity. It was greenish gray in color and gave off a foul odor. As it did not resemble an adenocarcinoma, the operation was completed. Cut section of the tumor showed a smooth pale homogeneous surface, softer than the usual fibroid. The pathologic report was as follows (extract from pathological report):

"Microscopic examination of the above described submucous tumor reveals a solid histoid vascular tumor with extensive areas of hemorrhage, degeneration, and necrosis. Groups of anaplastic, irregularly sized hyperchromatic cells are seen associated with numerous thin-walled blood vessels. The anaplastic cells have a large basophilic nucleus irregularly round to oval, containing nucleoli; some are multinucleated. The protoplasm is pale granular pink and varies in amount. Some of the nuclei are naked; others contain variable amount of pink granular protoplasm. Mitotic figures are numerous. Such groups of anaplastic cells imperceptibly merge into the surrounding tissue where they become elongated and slender. Their nuclei become lighter and vesicular, exhibit a definite nuclear membrane and one or two nucleoli. The cytoplasm increases in amount, becomes pink and granular and assumes a fibrillar structure. Here also are seen quite a variation in the size and shape of the nuclei and numerous mitotic figures. In places these cells are growing in a fascicular formation. The large anaplastic cellular areas are supplied by numerous thin-walled blood vessels and it is here that necrosis and hemorrhage is most extensive. Edema is quite pronounced throughout the tumor.

"Diagnosis: Huge solitary pedunculated submucous sarcoma of the uterus. Subacute to chronic left salpingitis with hydrosalpinx. Fibrous adhesions between the left oviduct, the atrophic ovary, and the uterus. Multiple intramural fibromyomas with calcification."

Knudtson, T. G.: Autotransplantation of the Ovary, *Acta obst. et gynec. Scandinav.* 17: 407, 1937.

The term auto-transplantation refers to the transfer of ovarian tissue from its normal situation to another portion of the body. Homologous iso-transplantation is the transfer of ovarian tissue from one woman to another and homologous allo-transplantation is the transfer of ovarian tissue from an animal to woman. Since hormone therapy of menopausal symptoms is so expensive and so much trouble, the author prefers autotransplantation. Since 1933 he has used this procedure in 16 cases and he has employed the Douay technique. This consists of transplanting pieces of ovary into the labia majora. In 10 women more than one year has elapsed since the operation. Six of these women have had excellent results up to three years. In none of the cases was there any local discomfort or symptoms. Relief from symptoms is not obtained until three months after the transplantation is made. However, it was found that the amount of anterior pituitary hormone in the urine decreases before the hot flashes subside. This indicates that estrin production commences before the hot flashes are relieved.

J. P. GREENHILL.

GRANULOSA CELL TUMOR OF THE OVARY WITH A CARCINOMA OF THE BREAST

RITA S. FINKLER, M.D., NEWARK, N. J.

(From the Surgical and Gynecological Services and Division of Laboratories,
Newark Beth Israel Hospital)

A 37-year-old married, white female was admitted to the Surgical Service of the Newark Beth Israel Hospital on May 19, 1936, for the removal of a large uterine fibroid. For the past six months she had complained of an increasing sense of pressure over the bladder and rectum. The menstrual history was normal; onset at the age of 12, occurring every twenty-eight days and lasting four or five days. There had been no increase in the frequency or the amount of flow. The last period occurred three weeks prior to admission. She was married and had one living child. There was no history of any other pregnancy. The past history is irrelevant, and the family history is negative, except that her mother had diabetes. The routine urinalysis showed 2.5 per cent glucose, and the blood sugar was 273 mg. per 100 c.c. of blood. A diagnosis of diabetes mellitus was made. The patient was temporarily discharged to be treated at home for her diabetic state.

She was readmitted on June 7, 1936. The pelvic examination revealed the uterus to be enlarged to about the size of a three and one-half to four months' pregnancy. A cystocele and a lacerated cervix were also found. The physical examination was otherwise essentially negative. On palpation of the breasts, no masses were felt, and there was no tenderness.

She was operated upon on the following day. At the operation a large uterus studded with many fibroids, and a right cystic ovary were found. The appendix was constricted at two points. A hysterectomy, right oophorectomy, and appendectomy were performed.

Summary of Pathologic Examination.—*Gross:* Specimen consisted of a supra-cervically amputated uterus, without tubes or ovaries. It was ovoid in shape and measured approximately 10 cm. in diameter. In the wall and beneath the serosa, were many circumscribed nodules ranging from 2 cm. to 5 cm. in diameter. They were all composed of whorls of dense gray tissue, with occasional pinkish, more cellular areas between them. The endometrium was congested. Received separately, was an ovary, 5 cm. in diameter. It contained a large cyst on whose lining were occasional small roughened excrescences. Besides the large cyst, the ovary contained two nodules. One measured 2½ cm. by 2 cm., composed of yellow, granular tissue, the other measured 1½ cm. in diameter and was composed of grayish, granular tissue. Received separately, was an appendix measuring 7 cm. in length with an average diameter of 4 cm. The lumen was obliterated at the tip.

The microscopic examination of the ovarian tumor revealed for the most part, a uniformly diffuse cellularity. The cells had a scant cytoplasm with uniform, fairly pyknotic, large nuclei. Mitotic figures were scarce. In places, these cells were arranged radially, about a cavity, in which there was eosinophilic material; the formation of these latter structures remotely resembled atypical follicles (Fig. 1). In addition, there were multiple fibromyomas with adenomyosis, a pronounced endometrial hyperplasia, and endometriosis of the appendix.

Following this diagnosis a bio-assay of the urine was carried out on the eighth day following the operation and revealed the presence of only 6 rat units of estrin and 25 mouse units of prolan per liter of urine. Her blood sugar during her stay in the hospital while receiving insulin therapy, varied from 188 mg. to 231 mg. per 100 c.c. of blood. The patient made an uneventful recovery and was discharged twelve days after the operation.

The bio-assay of the tumor tissue was carried out after the tissue had been in fixation for some time, and no appreciable amounts of estrin were found. The extract of the fixative fluid in which the specimen was preserved proved too toxic for the animals.

She was re-admitted to the Beth Israel Hospital on Sept. 18, 1936, for the removal of a small lump under the nipple of the right breast which the patient noticed five days prior to admission. Physical examination revealed a firm elongated nodule about 2 cm. in diameter. This was not attached to the skin. The nipple was not retracted.

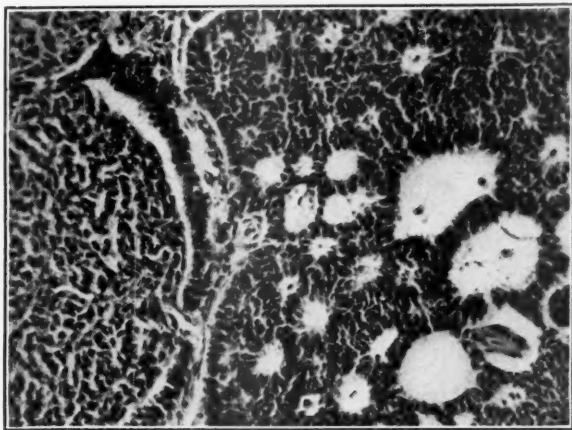


Fig. 1.—Granulosa cell tumor of the ovary showing radial arrangement of cells about a cavity resembling atypical follicles. In lower right hand corner is a more cellular area.

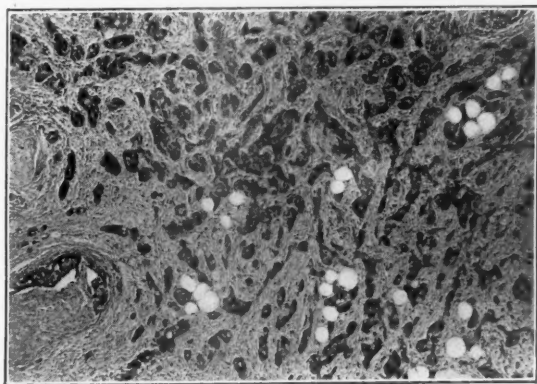


Fig. 2.—Scirrhus carcinoma of the breast.

She was operated upon on the following day. The lump was excised and the frozen section revealed a carcinoma. A radical mastectomy was then performed. A mass found in the axilla was also excised. The pathologic diagnosis was scirrhus carcinoma of the breast with lymph node metastasis (Fig. 2).

The patient made an uneventful recovery and was discharged Sept. 26, 1936. When last seen (May, 1937) no recurrence had been noted even though the patient absolutely refused to have postoperative radiation therapy.

In the light of the present knowledge of granulosa cell tumors of the ovary, and the questionable relationship between estrogenic and carcinogenic compounds,

the appearance of a carcinoma of the breast in a woman of 37 years of age, three months following the removal of a granulosa cell tumor of the ovary, must be considered coincidental until further observations on similar cases can be made.

The adenomyosis and endometriosis which was present in this instance is probably related to the ovarian tumor.

I am indebted to Dr. B. H. Greenfield and Dr. J. Flax from the Surgical Service of the Newark Beth Israel Hospital, through whose courtesy this case was reported, and also to Dr. William Antopol, Director of the Laboratories of the Newark Beth Israel Hospital, Newark, N. J., for his generous assistance in the preparation of this paper, and for the pathologic diagnosis on all tissues herein described.

35 LESLIE STREET

AN UNUSUAL CASE OF PLACENTA ACCRETA DISCOVERED AT CESAREAN SECTION

MILTON G. POTTER, M.D., F.A.C.S., BUFFALO, N. Y.

MATHIEU collected eight cases of this rare condition discovered at cesarean section and cites a ninth case. All of these patients were treated by hysterectomy and recovered. A report of a tenth case, in which it was impossible to remove the uterus, is herein cited.

Patient G. was a primipara, 35 years old, who had been married for twelve years. Her menstrual history had always been normal, in that her periods were regular, lasting approximately five days with no pain. She had a thyroidectomy in 1933. The last period noted before her pregnancy was Aug. 15, 1935 which would make the date of expectancy approximately May 22, 1936.

During the early stage of pregnancy, the patient was miserable, in that she had during the first four months, four acute terrific attacks of lower abdominal pain, which lasted for several days at a time. These attacks were so severe she would faint and could be controlled only with huge doses of morphine. During her last attack in November, 1935, which lasted one week, there was no bowel movement, and all attempts to correct this condition with enemas and cathartics failed, until the patient discovered that cider, by mouth, had the desired but painful effect.

From Jan. 1, 1936, the patient had no more attacks of pain and the family physician reports a normal prenatal period thereafter, with the feeling of life present until May 26, 1936 (four days after her expected time of delivery).

When the patient was one month over term, the family physician became alarmed, sent her into the hospital for induction of labor, which failed. After a stay of one week in the hospital, during which time the x-ray revealed a dead fetus and large uterine tumors, she returned home undelivered.

Another month elapsed (two months beyond her expected time of delivery) when the patient was again returned to the hospital by the family physician, who called for obstetric consultation.

At this time (July 29, 1936) all concerned were alarmed, even though this patient with a large hard abdomen, felt well. Pelvic examination revealed a dimple-like cervix with no demonstrable opening, either visibly or by bimanual examination. Realizing that delivery of the dead fetus through the vagina was impossible, a cesarean section was recommended and accepted.

Upon opening the abdomen above the umbilicus, it was discovered that the intestines and omentum were so densely matted together and so firmly adherent to the entire body of the uterus, which revealed numerous fibroids varying in size from a walnut to the size of an orange, that it was with great difficulty, that a space large enough was found to make the uterine incision. The tubes and ovaries could not be demonstrated.

After removal of the macerated fetus, the placenta, which had thinned out, was noted to extend over the entire length of the posterior portion of the uterus, with absolutely *no line of cleavage demonstrable*. It appeared to have grown into the wall

of the uterus and removal was impossible. Further exploration of the interior of the uterus revealed no demonstrable internal os, so with an assistant pressing his examining finger on the dimple-like cervix through the vagina, the operator cut down on the finger from the interior of the uterus in order to establish an opening for drainage. A gauze drain was placed in this opening, pulled through into the vagina, and the uterus closed in the routine manner, after the umbilical cord was amputated at the junction of the placental attachment. It was impossible to do a hysterectomy, because of the very dense adhesions of the intestines and omentum to the entire body of the uterus. A drain was inserted in the lower angle of the abdominal incision, patient was transfused, and was returned to her room with a bad prognosis.

The convalescence was stormy. After the third day, the drain in the uterus was removed through the vagina. There was little drainage from this source, but much from the drain in the abdomen.

Eighteen days postoperatively, she returned home in the ambulance, and during the first week at home, there was still no vaginal drainage but considerable drainage through the abdominal incision, which did not close until April, 1937 (nine months after the operation). During that period the patient was ambulatory.

In September, 1937 (fourteen months following the operation) she had a normal menstrual period, no period in October and a scanty period lasting approximately two weeks in November, 1937. Since then there have been no menstrual periods and her only complaint is an occasional hot flash.

In January, 1938 this patient was examined in our office. Vaginal examination revealed a nonmovable uterus about the size of a grapefruit and an external os of normal size, from which was exuding a small amount of clear watery discharge. The neck of the cervix was absent. The abdominal scar was firm, urine negative, bowels regular, blood pressure 150/70, weight 139 pounds. She claimed she never felt better in her life.

COMMENT

Our case demonstrates not only the successful outcome of leaving the placenta in the uterus, which in itself is unusual, in that it is the second successful case of this type to appear in the literature, but also demonstrates the point that placenta accreta is usually associated with other anatomical anomalies of the uterus.

As was previously stated, the external os appeared absent or so small as not to be visible, as was the internal os.

The presence of fibroids does not appear to be unusual in this type of case. The early prenatal distress this patient experienced can be explained by either the beginning degeneration of the fibroids, upon which the intestines and omentum became adherent with partial bowel obstruction, or the penetration of chorionic villi through the uterine wall into the omentum and intestines.

The former explanation of degeneration of the fibroids being the cause of the adhesions seems more likely because of what occurred during convalescence.

Undoubtedly the huge amounts of pus, which poured forth from the abdominal incision during the nine postoperative months, came from the continued degeneration of the large nodular fibroids.

This case is also unusual in that the patient was an elderly primipara with no abnormal menstrual history.

PUERPERAL INFECTION FROM VINCENT'S ORGANISMS

FRANK W. PEYTON, A.B., M.D., LAFAYETTE, IND.

E. N., 19-year-old primigravida, was first seen Oct. 11, 1937. Family history was negative except diabetes mellitus. Past history revealed no acute infection, the patient was always in good health with the exception of an occasional sore throat. Later she stated that she had never had or received treatment for Vincent's or "trench mouth," or had she ever been in close contact with anyone known to have the disease. Menstrual history was negative, the last period being March 20, 1937. The pregnancy had gone along quite uneventfully. Examination showed a well-developed and well-nourished female estimated to be about thirty weeks pregnant. Throat was negative, teeth somewhat carious, thyroid not palpable, heart and lungs negative, blood pressure 116/70, pelvic measurements small, large varicose redundant flap of anterior hymenal ring, cervix soft, not eroded and showed no evidence of infection (smear not taken). Urinalysis and blood Wassermann were negative.

Pregnancy continued on normally until two weeks before delivery when an attack of *coryza* occurred, with elevation of blood pressure to 134/90 which subsided under treatment. Contractions started following spontaneous rupture of membranes, Dec. 26, 1937. After a total labor of six hours the patient was delivered by means of outlet forceps following central episiotomy of a normal, full term, living male infant. Local infiltration and pudendal block with $\frac{1}{2}$ per cent novocaine supplemented oral paraldehyde analgesia for the delivery and repair of episiotomy. Placenta and membranes were expressed intact by modified Credé. Estimated blood loss was 150 c.c. One hour later the uterus had relaxed to the extent where the cavity contained a clot of approximately 500 c.c. After expression of the clot there was fair tonicity and patient bled, possibly, another 100 c.c. before complete cessation was brought about by oxytocics and massage.

The first six days of the post partum were uneventful, the highest temperature being 100° F. on the fourth day. Pulse ranged from 84 to 110. The lochia was moderate in amount, red in color the first four days, became scant and white on the sixth and seventh days. At no time was it foul. On the seventh day the patient experienced a chilly sensation following which temperature rose to 101° F. Examination revealed inflamed watery discharging nasal mucosa, extremely engorged breasts, chest clear, uterus 2 fingerbreadths above symphysis, firm and not tender. No tenderness over kidneys and the extremities were normal. Urinalysis was negative for albumin and cellular elements. The following morning (8th day) the temperature had risen to 103° F. Blood study showed 52 per cent hemoglobin, 3.2 million red blood cells and 16,000 white blood cells with 83 per cent being polymorphonuclears. The lochia suddenly became very profuse, fetid in odor, and varied during the day in appearance, from serosanguineous to greenish, thick mucopurulent containing an occasional minute clot of bright blood or a streak of blood. The patient had no complaints and was rapidly becoming more toxic, drowsy, and nauseated. The temperature was maintaining a rather constant level of 104° F. through the latter part of the day. Intravenous glucose, transfusion with 250 c.c. of citrated matched whole blood and sulphanilamide were administered. Early the ninth day a smear was taken of the lochia and under gentian violet staining the Vincent's organisms were discovered, there being 15 to 20 spirilla and 7 to 8 fusiform bacilli under oil immersion to the microscopic field. Innumerable *B. coli* and staphylococci were observed. Smears were negative for streptococcus, gonococcus, and *B. diphtheriae*. Blood culture and lochial culture were not done. At this time the patient was practically moribund. She was then receiving 2½ per cent glucose in normal saline by continuous phlebotoclysis. Another transfusion of 300 c.c. was resorted to. The temperature had ranged from 103 to 104° F. throughout the day, and pulse 132-144. It was felt that therapy so far was to no avail. Four hours following the transfusion she was given 0.3 gm. of neocarsphenamine intravenously.

Six hours after the neoarsphenamine was administered the temperature and pulse slowly fell and in eighteen hours were 100° F. and 116, respectively. The patient was then cheerful, alert, and asked for food. The lochia had lessened considerably but was still foul, and smear showed an occasional fusiform bacillus but no spirilla. Latter part of the tenth day temperature started up again and in twelve hours reached 103° F., pulse 124. Slight pain in pelvis began for first time, along with tiredness and depression. The temperature remained elevated and the following day (eleventh) a pelvic examination was done. The episiotomy wound was well healed, vaginal walls normal, cervix well involuted, stellate lacerations of os, and canal filled with a mucopurulent discharge. About the portio vaginalis there were three irregular reddened patches covered by a pseudomembrane. Smears were taken from the patches and cervical canal. Moderate tenderness was present in both adnexal regions upon gentle bimanual examination, but no masses were made out. No filling in of cul-de-sac. Again Vincent's organisms were found on the smears. Because of the recurrence of positive smears and fever, another 0.3 gm. of neoarsphenamine was administered. Temperature and pulse fell to normal levels in eight hours and the pelvic pain and tenderness disappeared. Except for unexplained single reading on the fourteenth day of fever to 101° F., the temperature continued normal until patient was released from the hospital on twentieth post-partum day. Patient appeared to be in good health when released, hemoglobin 68 per cent, pelvis normal, cervical patches had disappeared, and smear showed only an occasional staphylococcus.

The etiology of this infection can easily be accounted for by an endogenous or exogenous route. From 16 possible sources or contacts, the patient, her husband, three nurses (one in charge of perineal care) and an aid in the kitchen, all revealed definite fusiform bacilli and spirilla in smears from gums. It was also disclosed that three weeks previously a maternity patient on the same ward was suffering from Vincent's angina, but her infection was confined to oral cavity.

723 LAFAYETTE LIFE BUILDING

MULTIPLE PREGNANCY IN A SEPTATE UTERUS WITH RETAINED ADHERENT PLACENTA

ELIAS RAUCH, M.D., NEW YORK, N. Y.

(From the Service of the Jewish Maternity and Beth Israel Hospitals)

THE literature, while mentioning the possibility of the occurrence of multiple pregnancy in a septate uterus, discloses only a limited number of such cases. These pregnancies usually terminate in abortion for either one or both fetuses.

Vastal, in 1700, described a case of double uterus. Lane, in 1885, reported a case of double uterus with a fetus in each body terminating in abortion. DePage described a uterus with three cavities. Double uterus with a single pregnancy has been reported numerous times. Kats, in 1896, described two cases of abortion in bicornate uteri. Pfannenstiel, in 1892, collected 18 cases of full-term pregnancies in two uteri. Jellinghaus also reported a case of multiple pregnancy in a double uterus with abortion. Houlton, in 1925, reported a case of multiple pregnancy in a uterus bicornis bicollis.

C. W., aged 25, para 0, gravida i, was admitted to the Prenatal Clinic of the Jewish Maternity Hospital in the seventh month of pregnancy. She had already gained 51 pounds during her pregnancy. The prenatal, past, and family history were essentially negative. Vaginal examination at this time disclosed a septate vagina.

On November 12, in the thirty-sixth week of pregnancy, she was admitted to the Jewish Maternity Hospital with a history of ruptured membranes, but not in labor. There was some pitting edema of both ankles. Blood pressure was normal. A

diagnosis of multiple pregnancy was made, one vertex and one breech presentation. The cervix was one and one-half fingers dilated, and x-ray film at this time verified our findings. At 12:15 P.M., on Nov. 13, 1936, the patient began to have uterine contractions. Fifteen hours later the cervix was fully dilated. Weak contractions were present. One and one-half hours later, three minims of pituitrin were given and repeated three times, so that in one and three-quarters hours she received a total of 12 minims of pituitrin with no effect on the uterine contractions. The septum in the vagina was severed and tied. After three and three-quarters hours in the second stage of labor, the first fetus, weighing 4 pounds, was delivered by low forceps. The second fetus, weighing 4.5 pounds, was extracted twenty minutes later after artificial rupture of the membranes. Fifteen minutes after the second delivery one placenta was expressed. An attempt at expressing the second placenta was made with no avail. Manual removal was attempted at this stage, after a loss of about 700 c.c. of blood. Up to this time the diagnosis had not been made and on inserting the hand into the uterus it did not seem to allow enough space to palpate the cavity of the uterus nor the placenta and, with the patient in incipient shock, a pulse of 160, it was decided to leave the placenta in situ and pack the uterus. Sixteen yards

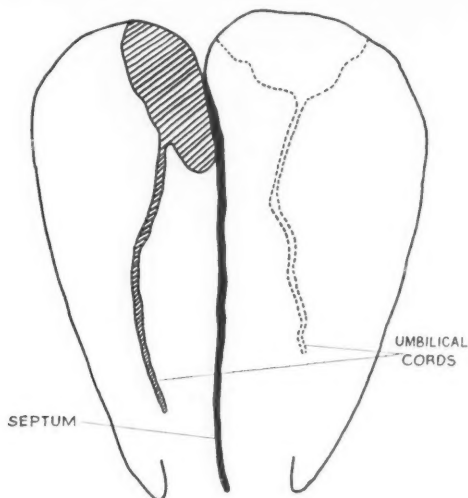


Fig. 1.

of iodoform gauze were inserted. Hypodermoclysis of 1,000 c.c. of saline with 5 per cent glucose was given. Shock treatment was instituted and the patient was put back to bed.

On the following day the patient had a chill for twenty minutes and a temperature of 104° F.; pulse 122; and respirations 24. Feeling that the placenta in the uterus was the source of the temperature and chill, it was decided again to attempt manual removal of the placenta. At this time the diagnosis of septate uterus was made. It was impossible to get a hand into the uterus to grasp the placenta which was attached high up in the fundal septal angle, where the septum and the fundus met. It was impossible to guide a placental forceps up to the body of the placenta and only very small pieces of it could be removed. The patient again went into incipient shock with a pulse of 170 to 190, and the uterus was again packed.

A transfusion of 500 c.c. of whole blood was given and appropriate shock treatment was again instituted. Hysterectomy was then decided upon. She was taken to the operating room and a supravaginal hysterectomy done, following which she again received a 500 c.c. transfusion. Pathologic specimen revealed a septate uterus with a retained placenta in the right horn which separated easily. The patient developed a wound infection but recovered fully.

PATHOLOGIC REPORT

Gross.—Somewhat asymmetrical appearing uterus with arcuation, total length 14 cm., transverse diameter 14 cm., indentation 8 mm.; the left side has a thickness of 5.5 cm., the right 6.75 cm. The cut edge had an ovoid opening, with a transverse diameter of 7 cm. and an anteroposterior diameter (in its present condition) of 2.5 cm. There was a sagittal septum which measured about 3 mm. in thickness; after stretching the septum it measured 5.5 cm. The serosa appeared normal except for some distended veins and a few small, firm, slightly protruding, grayish-white spots (small myomas?). The ligaments were cut short. In the upper portion the specimen was rather soft with little difference in consistency between the both sides. The lower portion was moderately firm.

On the left side the inside of the uterine cavity was diffusely light brownish red with numbers of small, soft coagula, partly lying loose on the surface, partly adherent. Numbers of distended thrombosed veins were seen in the wall, notably in the middle of the fundus.

On the right side a placenta was inserted, occupying the upper half of the specimen. Otherwise the surface looked as described from the other side. The placenta separated easily. The cut edge on this side did not show thrombosed veins, but some very wide empty ones. A flat fairly soft, inelastic piece 5 by 2.5 cm., purplish-gray, without distinct markings showed on microscopic section a probable decidual origin.

COMMENT

This case either was one of superfetation, with the fertilization of the two ova in the same or different menstrual cycles, or simultaneous impregnation of two ova, one from each ovary, with nidation of each in a separate compartment of the septate uterus; each fertilized ovum having its own corpus luteum. Because of the half pound difference in size of the fetuses, the first supposition, superfetation, is probably the correct one.

515 PARK AVENUE

COMBINED INTRA- AND EXTRAUTERINE PREGNANCY

M. EDWARD MARTEN, M.D., AND LEO M. MEYER, M.D., BROOKLYN, N. Y.

(From the Department of Pathology, Samaritan Hospital)

COMBINED uterine and tubal pregnancies have been recorded relatively frequently (7 cases in the first half of the year 1937). Frank, in his textbook, states that extra- and intrauterine pregnancies occurred once in 105 ectopics. Teacher makes only casual mention of the subject in his book. In 1913 Neugebauer collected 243 cases of combined pregnancies. Novak reviewed the literature from 1913 to 1926 and added 32 more cases, and discussed fully the incidence, clinical characteristics, diagnosis and treatment of this unusual condition. Hefferman and Faxon, in 1935, summarized the literature up to that year and found a total of 282 cases.

CASE REPORT

Mrs. C. I., white, age 26 years, para i, gravida iii, was admitted to the Gynecological Service on Oct. 8, 1937, complaining of cramp-like pains in the lower abdomen of one week's duration. These abdominal pains were associated with vomiting, dizziness and weakness. Her past history indicated a spontaneous full-term delivery three years prior to the present illness. Subsequent to this the patient had a miscarriage followed by a curettage five months prior to her admission to the hospital. The patient last menstruated on Aug. 12, 1937. Up until this date her periods had been regular every twenty-eight days lasting two to four days. No history of vaginal bleeding was associated with the present attack of abdominal

pain and weakness. A review of the other general systems revealed no other abnormalities. Physical examination disclosed a patient who was in shock and markedly anemic. The entire lower abdomen was tender. A diagnosis of ruptured ectopic pregnancy was made. At operation a ruptured left tubal pregnancy was found. The tube and its contents were removed. The peritoneal cavity was cleared of a large amount of fresh blood. The uterus was twice the normal size. This organ was incised and a fetus and placenta were found close to the left cornu. These were removed. The patient's postoperative course was relatively mild. Transfusion and venoclysis were resorted to and she left the hospital on Oct. 26, 1937, eighteen days after her admission.

Pathologic Report.—Specimen consisted of a tube 10 cm. in length, the proximal portion of which was dilated, dark red in color and measuring 5 cm. in diameter. In the hemorrhagic area of the tube was an opening communicating with the lumen. In the lumen was a fetus, 1.8 cm. in length, which was completely enveloped by its membranes. Accompanying the tube was the fetus removed from the uterus which measured 3.7 cm. in length, and its placenta.

COMMENT

The above case is of special interest because of the difference in size of the two fetuses. The question of superfetation naturally arises in all twin pregnancies. Since the fetus from the tube was so much smaller than its mate from the uterus, one could assume that the smaller one was the younger. On the other hand, the tube being an heterotopic site, it might not have predisposed to the normal rate of growth and hence the smaller size.

Murray, Edmundo G.: Changes in the Cells of the Vagina, Arch. f. Gynäk. 165: 635, 1938.

The author describes a simplified method of cell counts in vaginal strippings. From his studies on 128 women he concludes that the vaginal mucosa undergoes two definite cycles, a "folliculin phase" and a "lutein phase." During the folliculin phase, the vaginal mucosa undergoes marked regeneration especially in the superficial layers. During the lutein phase marked proliferation of the stratum germinativum and the stratum spinosum takes place.

The vaginal mucosa remains in the lutein phase throughout pregnancy, and the author was unable to find any evidence of cyclic changes. Acute inflammatory conditions of the mucosa result in marked inhibition of these cyclic changes. Genital hypoplasia and primary amenorrhea produce a definite atrophy which can be overcome by the administration of estrogenic substances. By contrast, secondary amenorrhea and irregularities of menstruation result in excessive cyclic changes in the vaginal mucosa. These changes can also be brought back to normal by the use of estrogenic hormones.

The senile vagina shows less differentiation than does the menopausal vagina. Four types of atrophy are described in detail, the author believing that this type of fine differentiation is helpful in arriving at a true definition of the functional and clinical status of the genitalia.

RALPH A. REIS.

MODIFICATION OF HILLIS-DELEE OBSTETRIC STETHOSCOPE

RICHARD TORPIN, M.D., AUGUSTA, GA.

*(From the Department of Obstetrics and Gynecology, University of Georgia
School of Medicine)*

THIS modification consists of a head band with a four or five inch projecting rod with the distal end bifurcated and assembled with a thumb screw to form a clamp for the bell portion of any stethoscope as illustrated in Figs. 1 and 2. Its value has been demonstrated by six years' use in clinic and private practice. The chief advantage lies in the ability of the obstetrician to use a stethoscope to which he is accustomed.

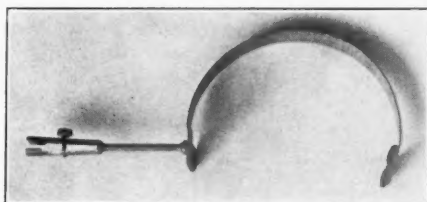


Fig. 1.

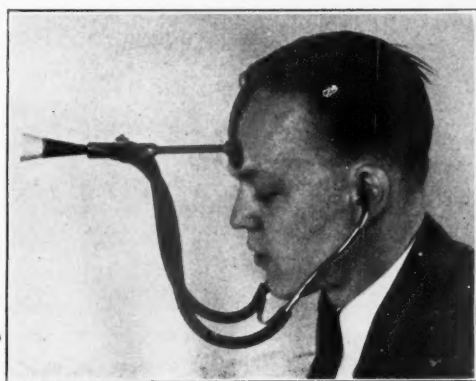


Fig. 2.

Since its introduction twenty years ago the Hillis-DeLee head stethoscope has become an essential part of the equipment of almost all modern hospital delivery rooms. However it is of great value in the prenatal examination of patients in the clinic or in the individual physician's office where it is often lacking because of the expense. This modification which does not require the additional cost of an attached stethoscope is far less expensive to manufacture and should sell for not more than a third of the cost of the original model.

Correspondence

Dear Editor:

The practice of medicine in our "poor white" mountain districts of the South is a baffling proposition and one which I feel our best social-medical minds should be working on.

The grub farmer living far up on a creek or the miner living in an abandoned mining camp has two choices in time of sickness. He may hire a car and go twenty-five miles to either a town physician, the county health doctor, or the mining camp physician; or he may send for a doctor for a fee which may mean the sale of his cow or hog which is part of his next year's food supply.

No one is to blame for this condition. Most creek calls involve a half day in time and extreme wear and tear on the car, which makes a high fee necessary. As a result of this, the mountain people are in the habit of employing all sorts of weird home remedies, granny midwives, local "cancer doctors," and faith healers. As is to be expected there is no prenatal care with the resulting high maternal and infant mortality. Ordinary child hygiene is practically unknown.

The population is increasing at such a rate that suddenly we are going to awake to the fact that we have a large group of people physically and mentally unable to cope with our present civilization.

Should not the medical profession as a whole express some interest in this situation which is not only a future menace, but a dark blot on our medical conscience?

ELEANOR HAMILTON, M.D.

Myra, Kentucky,
August 5, 1938.

NOTE: This communication comes from a little mining town in the mountains of eastern Kentucky, which is well termed a "Medical Missionary Outpost." It is written by a well-trained young physician who is duly appreciative of the difficulties which beset these people in obtaining adequate care in pregnancy. How shall this problem be solved? Is it to be by the systems of relief so widely disseminated at the present time, with their doubtful effect on mind and body, or shall it be by some system of adequate medical service developed and supervised by the profession itself? It seems necessary to build up a broader and a different program, for the social, economic-medical question is confusing, and it is difficult to speak with clearness until sufficient familiarity has been gained by constant association with the problem. The doctor, with a public health and sociologic point of view, should be able to supply the necessary guidance. But what can he do without funds, either of the individual or the community, and how shall these be employed?

The Federal Children's Bureau is endeavoring to supply an answer. Let us hope it can be done successfully without an overpowering bureaucracy, which is frequently debilitating rather than helpful. There must be a way to answer Dr. Hamilton's questions and those of others like her, in similar, often thankless, positions.

EDITOR.

Society Transactions

CHICAGO GYNECOLOGICAL SOCIETY

MEETING OF APRIL 15, 1938

The following papers were presented:

Two Cases of Intersexuality. Dr. William J. Carlisle and Dr. C. J. Geiger. (For original article, see page 1047.)

Technic and Results of Routine Fetal Electrocardiography During Pregnancy. Dr. Erwin O. Strassmann. (For original article, see page 986.)

A Case of Acephalus Holoacardius. Drs. Henry Buxbaum and David V. Wachsman. (For original article, see page 1055.)

The Experimental Production of Intersexuality in the Female Rat. Drs. R. R. Greene, M. W. Burrill, and A. S. Ivy. (For original article, see page 1038.)

Liver Presentation. Dr. Edward Allen. (For original article, see page 1060.)

Sarcoma of the Uterus. Dr. W. C. Danforth. (For original article, see page 1062.)

BROOKLYN GYNECOLOGICAL SOCIETY

MEETING OF APRIL 1, 1938

The following papers and discussions were presented:

Dysmenorrhea. Drs. Lawrence Kurzrok, C. Burnberg and S. Livingston.

A Comparative Study of the Classical and Cervical Cesarean Sections at the Brooklyn Hospital in a Series of 164 Cases. Dr. John Casagrande. (For original article, see page 1033.)

Supravaginal Hysterectomy. Dr. W. T. Dannreuther.

Department of Reviews and Abstracts

CONDUCTED BY HUGO EHRENFEST, M.D.

Selected Abstracts

Ovarian Pathology

Béclère, C.: Etiology and Pathogenesis of Uterine Hemorrhage of Ovarian Origin, Bull. Soc. d. obst. et de gynéc. 26: 759, 1937.

Béclère has had occasion to study 158 cases of functional hemorrhage of ovarian origin in a total of 280 hysterosalpingographies performed in women with hemorrhage of unknown origin.

Uterine hemorrhage of ovarian origin may be divided into 2 groups. In the first there is a tumor of the ovary either liquid or solid. These cases are uncommon. In most cases the ovary is normal in size and the hemorrhages occur during active sex life. The author divides the latter group into three classes, namely, hemorrhages due to congenital lesions of the ovary (15 cases), hemorrhages due to infection of the ovary (93 cases), and hemorrhages due to premenopausal ovarian disturbances (50 cases).

Clinically there may be increased menstrual flow, irregular bleeding, and periods of amenorrhea alternating with hemorrhage. Histologically there is found benign glandular hyperplasia. The author believes that it is by means of hystero-graphy that we can best separate the cases of functional bleeding from those associated with lesions. The uterine image may be normal but usually there is a jagged uterine picture first described by the author. One observes a series of small contiguous projections in a normal-sized uterine cavity.

In the cases of uterine bleeding due to congenital disturbances, a cure may be brought about by the use of corpus luteum hormone. In the cases due to infection, diathermy and anti-infection vaccines produce quick relief. For the premenopausal group, roentgen ray therapy is the treatment of choice.

J. P. GREENHILL.

Opocher, E.: The Sclerotic Degenerative Changes of the Ovary, Folia Demograph.-Gynaec. 34: 523, 1937.

Studying 927 cases in which sclerotic changes in the ovary were found at operation, the author concludes that the clinical expression of these changes is manifested in three principal symptoms: Pain, menorrhagia or metrorrhagia, and sterility. The diagnosis is always difficult, if not almost impossible, especially when there exist other symptoms referable to the genital organs.

Therapy must of necessity be varied according to the particular condition in each case, but the author feels that in aggravated cases the treatment usually is surgical, consisting in resection of the ovary. This procedure has given the author good results, both primary and remote.

MARIO A. CASTALLO.

Cooke, W. R.: Cystic and Solid Tumors of the Ovary, Texas State J. Med. 32: 759, 1937.

Studying the ovarian tumors seen in the laboratory of the University of Texas from 1927 to 1935, the author arrives at the following conclusions: (1) Most ovarian cystic masses are harmless, undergo spontaneous resolution and rarely require operation except on account of development of such accidents as hemorrhage,

torsion, or infection. (2) The relatively few ovarian cysts which require operative removal for cure rarely become a menace to the life of the patient until they have attained a size or an age beyond the ordinary limits of the harmless types of cyst. (3) Hence, in the case of small cysts, operation should be deferred (under frequent observations) until a reasonable certainty exists that the cyst is of the type which will require operative removal for cure.

J. P. GREENHILL.

Bufe, W.: Frequency of Cysts of the Ovary as an Accidental Finding During Autopsies, Zentralbl. f. Gynäk. 61: 632, 1937.

In a series of 100 pairs of ovaries removed at autopsies, Bufe found cysts present in 77 per cent. The types of cysts encountered were: small cystic degeneration, 22 per cent; follicle cysts, 55 per cent; corpus luteum cysts, 9 per cent; hilus cysts, 7 per cent; and parovarian cysts, 2 per cent.

J. P. GREENHILL.

Varangot, J.: A Tumor of the Theca Interna of the Ovary, Bull. soc. d' obst. et de gynec. 26: 699, 1937.

During the last few years a special group of tumors have been isolated from ovarian neoplasms which manifest endocrine activity and secrete the estrogenic hormone. In this special group which may be called feminizing tumors, there are two anatomic varieties, one of which arises in the granulosa and the other in the theca interna. Varangot reports a case of the latter variety. The tumor consisted of a fibroma of the ovary which contained large quantities of intracellular cholesterides. Thus far 23 cases of this kind have been reported, the first ones having been described by Loeffler and Priesel. Varangot saw another case in Montreal.

J. P. GREENHILL.

Mocquot, Moricard, Palmer, and Gothié: A Case of Thecal Tumor, Bull. Soc. d' obst. et de gynec. 26: 703, 1937.

The authors report a thecal tumor of the ovary in which the manifestations of estrogenic activity were particularly intense.

J. P. GREENHILL.

Patterson and McCullagh: A Case of Theca-Cell Tumor of the Ovary in a Woman Aged 92 Years, J. Obst. & Gynaec. Brit. Emp. 43: 1186, 1936.

This case is recorded as an example of a rare ovarian tumor occurring in extreme old age. It appears to be the oldest recorded case by a wide margin. The growth proved to be of the theca-celled type of granulosa-cell tumors.

The patient, aged 92 years, was admitted in December, 1935, for backache and vaginal bleeding due to an abdominal tumor the size of a large grapefruit, which felt like a pedunculated fibroid.

The menopause occurred thirty-six years before, but four years ago slight irregular vaginal losses of blood had begun, and these lately became continuous, worse at intervals.

Subtotal hysterectomy was performed and both tubes and ovaries were removed.

The endometrium showed estrogenic hypertrophy with cystic dilatation of the glands, and resembled the normal premenstrual endometrium of a young woman, but the hypertrophy was more marked.

J. P. GREENHILL.

Harms: Granulosa Cell Tumors in Young Girls, Zentralbl. f. Gynäk. 61: 17, 1937.

The author describes two granulosa cell tumors seen in girls 8 and 14 years old, respectively. The eight-year-old girl developed a precocious puberty. In both cases estrogenic hormones were demonstrated in the tumor implants. In the child with

precocious puberty there was an unexplained positive Aschheim-Zondek reaction present. These cases illustrate that uterine hemorrhages in young girls should arouse a suspicion of granulosa cell tumor.

J. P. GREENHILL.

Rhoads, J. E., and Terrell, Alexander W.: Ovarian Fibroma With Ascites and Hydrothorax (Meig's Syndrome), J. A. M. A. 109: 1684, 1937.

The knowledge that this association of pleural effusion with a benign fibromatous tumor of the pelvis exists is extremely important from the standpoint both of prognosis and of treatment, since most pelvic tumors causing pleural effusion are malignant and the effusion is the result of pleural or pulmonary metastases. A series of seven cases presenting the syndrome of fluid in the chest in association with ovarian fibroma were recently reported by Meigs and Cass. The authors report another case in which the tumor weighed 810 gm. and in which the amount of fluid in the chest exceeded the amount of ascitic fluid. No satisfactory explanation of the associated hydrothorax has as yet been offered.

GROVER LIESE.

Glasunow, M.: The Histology and Histogenesis of So-called Ciliated Epithelial (Serous) Cysts of the Ovary, Arch. f. Gynäk. 164: 358, 1937.

The author studied 15 cases of so-called ciliated epithelial tumors (cysts) of the ovary and concludes that this type of epithelium is identical with that of the uterine tubal mucosa rather than resembling that of the ovarian tunica as was formerly held. Such cysts arise from postnatal implantation of Müllerian epithelium although some may arise from embryonic rests of Müllerian ducts. These cysts should, therefore, be called either tubal epithelial cysts or Müllerian cysts. This epithelium produces mucus but only in small quantities. The term pseudomucinous is an all inclusive one including both the type of cyst under consideration and others of different histogenesis. Müllerian duct epithelium can and does produce ciliated epithelial cysts as well as pseudomucinous cysts.

RALPH A. REIS.

Pund and Gotcher: Granuloma Venereum of Uterus, Tubes, and Ovaries, Surgery 3: 34, 1938.

The patient, a 28-year-old negress, on admission complained of vaginal hemorrhages for last two months. She had a palpable mass in left lower abdominal quadrant, noticed first five months ago and gradually enlarging. Further examination showed a large, red, easily bleeding cervix and a hard mass, filling pelvis and reaching up almost to navel. Wu and Kahn reactions negative. Under conservative observation, with preliminary diagnosis of chronic inflammatory process, temperature fluctuated between 100° and 104° F. After two months the genitalia were removed. Operation was very difficult and patient died next day. Necropsy refused.

Microscopic study of removed organs established a heretofore undescribed entity, namely involvement of uterus, tubes, and ovaries by a granuloma inguinale. Apparently this infection can ascend following delivery. In a previous paper (J. A. M. A. 108: 1401, 1937) these same writers had discussed in detail a case of granuloma venereum of the cervix uteri closely simulating carcinoma.

HUGO EHRENFEST.

Books Received

PRACTICAL CLINICAL GYNECOLOGY. By Henry C. Falk, M.D., Clinical Professor of Gynecology, New York University College of Medicine, etc. Illustrated, 393 pages. American Journal of Surgery, New York, 1938.

A CHALLENGE TO SEX CENSORS. By Theodore Schroeder. Privately printed. New York City, 1938.

ENDOGENE ENDOKRINOTHERAPIE IN DER GYNAEKOLOGIE. Aetiologie und Behandlung des Karzinoms. Von Dr. Jules Samuels, Chirurg und Frauenarzt in Amsterdam, etc. 182 Seiten. A. W. Sijthoff's Uitgeversmaatschappij, N. V. Leiden-Holland, 1938.

BLUTUNG UND FLUOR. Von Professor Dr. Hans Runge, Universitaets-Frauenklinik, Heidelberg. Dritte verbesserte Auflage, mit 17 Abbildungen. Theodor Steinkopff, Dresden, 1938.

SEXUAL HORMONE. Von R. Oppenauer and F. Dessau. 121 Seiten. Uitgeverij Dr. W. Junk, Den Haag, 1938.

THE PITUITARY GLAND. An investigation of the most recent advances. Proceedings of the Association for Research in Mental and Nervous Diseases, December 28 and 29, 1936. Williams & Wilkins Company, Baltimore, 1938.

MATERNAL CARE, Complications. Prepared under editorship of Dr. Fred L. Adair, and approved by the American Committee on Maternal Welfare, Inc. University of Chicago Press, 1938.

CLINICAL ROENTGENOLOGY OF THE DIGESTIVE TRACT. By Maurice Feldman, M.D., Assistant Professor of Gastroenterology, University of Maryland, etc. With 357 illustrations in the text, 1014 pages. William Wood & Co., Baltimore, 1938.

GINECOLOGIA OPERATORIA. Indicaciones y tecnica. Par Eduardo A. Fox and Jose A. Ibarra, Servicio del Hospital Rivadavia, Buenos Aires. Ancieto Lopez, editor, Buenos Aires, 1936.

TEXTBOOK OF GYNECOLOGY. By Arthur Hale Curtis, M.D., Professor and Chairman of the Department of Obstetrics and Gynecology, Northwestern University Medical School, etc. Third edition, reset; 603 pages with 318 illustrations. W. B. Saunders Company, Philadelphia, 1938.

A B C OF THE VITAMINS. By Survey in Charts. By Jennie Gregory, M.S. Foreword by Walter H. Eddy, Professor of Physiologic Chemistry, Teachers College, Columbia University. Williams & Wilkins Company, Baltimore, 1938.

DISEASES OF WOMEN. By Ten Teachers, under the direction of Clifford White. Edited by Sir Comyns Berkeley, Clifford White and Frank Cook. Illustrated, 492 pages. Sixth edition. William Wood and Company, Baltimore, 1938.

THE MAN TAKES A WIFE. A Study of Man's Problems in and through Marriage. By Ira S. Wile, M.D. 277 pages. Greenberg, Publishers, Inc., New York, 1937.

ADVENTURES IN RESPIRATION. Modes of Asphyxiation and Methods of Resuscitation. By Yandell Henderson. Illustrated, 316 pages. Williams & Wilkins Company, Baltimore, 1938.

GRUNDLAGEN DER GYNAEKOLOGISCHEN KURZWELLEN-THERAPIE. Von Dr. med. Ernst Raab, Berlin. Mit 29 Abbildungen, 66 Seiten. Ferdinand Enke Verlag, Stuttgart, 1938.

INNERE MEDIZIN IN DER CHIRURGIE. Von Dozent Dr. H. Frh. v. Kress, und Dr. W. Kittler, chirurgische Universitäts-Klinik in München. 144 Seiten. Ferdinand Enke Verlag, Stuttgart, 1938.

BIOGRAPHY OF THE UNBORN. By Margaret Shea Gilbert. Illustrated, 132 pages. The Williams & Wilkins Company, Baltimore, 1938.

PRINCIPLES AND PRACTICE OF MEDICINE. Originally written by the late Sir William Osler. Thirteenth edition, revised by Henry A. Christian, Hersey professor of the theory and practice of physic, Harvard University; physician in chief, Peter Bent Bingham Hospital, Boston. 1424 pages. D. Appleton-Century Company, Inc., New York, 1938.

NURSING, an Art and a Science. By Margaret A. Tracy, R.N., A.B., M.S., director, Training School for Nurses, University of California, San Francisco, and Collaborators. 559 pages with 183 illustrations. C. V. Mosby Company, St. Louis, 1938.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. By W. A. Newman Dorland, A.M., M.D., F.A.C.S. Eighteenth edition, revised and enlarged, with 942 illustrations, including 283 portraits, 1607 pages. With the collaboration of E. C. Miller, M.D., College of Virginia. W. B. Saunders Company, Philadelphia, 1938.

Item

American Board of Obstetrics and Gynecology

The general oral, clinical and pathological examinations for all candidates, Part II Examinations (Groups A and B), will be conducted by the entire Board, meeting in St. Louis, Missouri, on May 15 and 16, 1939, immediately prior to the annual meeting of the American Medical Association. Notice of time and place of these examinations will be forwarded to all candidates well in advance of the examination dates.

Application for admission to Group A, May, 1939, examinations must be on file in the Secretary's Office by March 15, 1939.

Application blanks and booklets of information may be obtained from Dr. Paul Titus, Secretary, 1015 Highland Building, Pittsburgh (6), Pennsylvania.

Dr. Floyd E. Keene, of Philadelphia, a member of the Editorial Board of the JOURNAL and a frequent contributor to its pages, died at his home in Wynnewood, Pa., on November 15, 1938. An appropriate obituary will be published in a forthcoming issue.

In the article by Dieckmann and Brown "Hypertension and Pregnancy" in the November issue, page 811, the table heading should read "B.M. (44575) Pre-eclampsia" instead of "Basal Metabolism," B.M., representing the patient's name.

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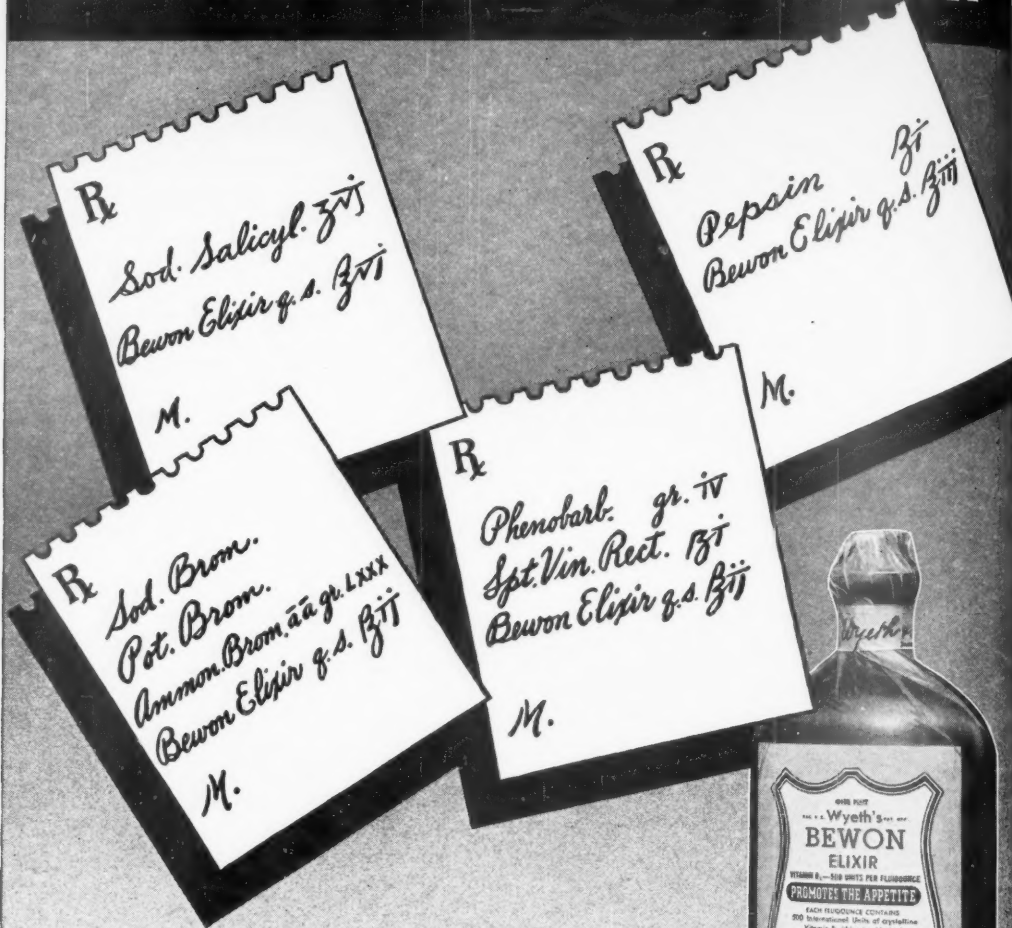
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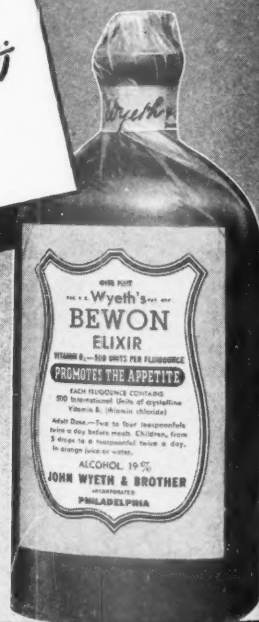
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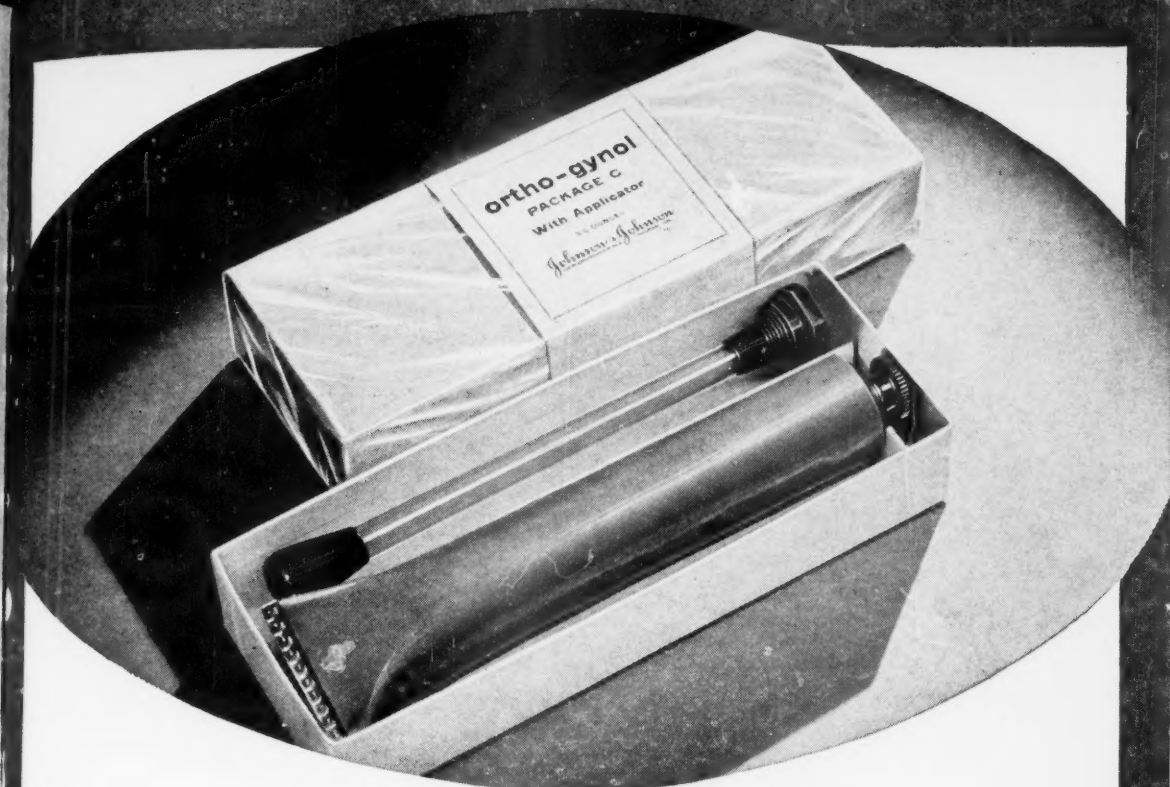


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